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THE PATTERNSHOP AND THE FOUNDRY.

IT is the duty of the foundryman, no matter to what department he may belong, to arrange his work in such a way that it will give the least possible trouble to those into whose hands it has to pass during its progress through the works. The success of every department in a foundry depends to a great extent on the consideration their requirements have received by those who proceed them, or the consideration they give to those who follow them in the chain of the industry.

The prevailing system in many foundries is that the pattern department is the centre to which all other departments look for consideration of their special requirements.

The introductory remarks, therefore, apply more directly to the pattern-maker than to any of the other branches of the foundry trade. To be thoroughly competent, the pattern-maker should not only be conversant with the technical difficulties to be met with in his own trade, but should be able to detect any troubles which are likely to arise in any of the other departments; and make provision in the pattern, as far as practicable, that these may be reduced to a minimum. In trying to meet with these demands the pattern-maker, if he has the interest of his work at heart, will find a splendid field for exercising the resources of his inventive genius.

The pattern-maker experiences more difficulties, owing to the nature of his trade, than are to be met with in many other trades.

The reason for this is that seldom is he called upon to make a pattern which is an exact repetition of one which has already passed through his hands.

Every new pattern, although possessing many of the principles common to other patterns, requires to be thought out independently, and treated according to its particular requirements.

Let us consider what are the principal features necessary in a pattern; it should

conform with the requirements of the design; it should be made in such a way that the moulder will have the least possible trouble, and its cost should be kept down to a minimum.

Another important consideration is, when the casting is to form part of a structure, that proper provision should be made in order that the fitting department should have little difficulty in carrying through its part of the work.

It is, therefore, the duty of the pattern-maker to arrange his work that each of the above points should have its fair share of consideration, and when this is carried out the pattern may be said to be as near perfection as it is possible to make it.

It is essential, therefore, that a thorough understanding should exist between the pattern-shop and the other departments in the foundry if the work is to be carried through in a business-like and systematic manner.

At times the pattern-maker has no choice but to follow strictly to the details given.

More often than otherwise there is a certain amount of latitude allowed to his discretion, and the advantage to which he puts this liberty in furthering the needs of the other departments forms a means of judging his capabilities and true value as a tradesman.

It will thus be seen that the pattern-maker is responsible to several departments for the proper conduct of his work, and for this reason there is no other branch of the foundry trade whose work is subject to so much criticism. Criticism has been defined as "the art of judging with propriety concerning any object."

Now, before one can give a criticism, he should have before him all the circumstances which led to the work being carried out in any particular way; and when that course has been adopted he should then be conversant with the difficulties which have to be overcome in carrying through the work.

In many cases there is sufficient cause for justifying the adverse criticism we hear passed on many patterns.

In pattern-making, as in other trades, there are inferior or inexperienced workmen, for no trade is without them, and many of the complaints against patterns are the result of the attempts of these workmen; but this does not cover the whole field of the complaints. Many of the troubles that are to be met with by the pattern-maker are caused by a want of practical knowledge on the part of the draughtsman, who introduces intricacies into the work which might very well be kept out, if he only knew the extra work entailed in overcoming them.

This also must be considered in reviewing the work of the pattern-maker, and when worries of this nature are encountered a share must naturally be borne by the moulder.

When touching upon this subject it might be stated that this question of impracticable designing will be an everlasting complaint, until we have some system of recruiting our draughtsman and others in responsible positions from the ranks of the workers, who know exactly what the requirements of the practical man are, and are able to devise means which will be to his assistance in carrying through the work.

There have always been, and probably will be, two classes of pattern-makers, those who stand at their benches and go through their work with little conception of why the results turn out as they do, and who never have anything original to suggest; their work is a mere copy, and sometimes very inferior at that.

The creations of this class of workman are to be seen daily in many of our moulding shops.

There is, happily, the other class of man, who makes no move without knowing why and how the results are obtained, who knows exactly what he is aiming at, and what the result will be when he has completed his task.

It is a mistake to rush a pattern through the pattern-shop and find, when it reaches the moulding-shop, it causes no end of trouble. Here it is that adverse criticism is warranted.

A moulder has plenty of trouble in the ordinary course of his business without the annoyance of an ill-made and unworkable pattern. A bad pattern is an item which is never considered in the time allowance for producing a casting.

It sometimes happens that it is politic to spend as little time as possible on a pattern from which, perhaps, there is only one casting required.

The extra expense in moulding is more than compensated for by the saving in time on the pattern, but even under circumstances such as these there is no excuse for mistakes, such as the absence of draw.

We have the converse side of this when we find highly-finished patterns on which time and expense have not been spared,

but are comparatively useless for want of proper consideration of how they should be moulded.

Unvarnished patterns are another general complaint.

In some pattern-shops, to varnish a pattern is considered a needless expense and a waste of time.

Moulders know from experience the saving of time, and the superior finished quality of the casting turned out from a varnished against an unvarnished pattern.

Many mistakes are caused by the want of a thorough knowledge in the art of moulding on the part of the pattern-maker.

These mistakes more often occur when the pattern department is isolated from the moulding department, such as in engineering shops, where it is the custom to procure their castings from an outside maker. The pattern-maker, in such a works as this, is at a disadvantage, owing to the fact that he cannot consult with the moulder for guidance as to how a pattern should be constructed in order to facilitate the moulding.

When the pattern- and moulding-shops are in conjunction with one another there should be no cause for complaint regarding patterns; for should there be the least cause for doubt as to what is the best method for constructing the pattern to suit the convenience of the moulder, his advice can at once be obtained.

It is essential, therefore, that the utmost cordiality should exist between the pattern and foundry departments, and it is the duty of the superintendent who is in charge to see that such a relationship does exist, for no department, more especially the pattern- and moulding-shops, can work to their master's interest if there is not a mutual understanding that each must work to the interest of the other.

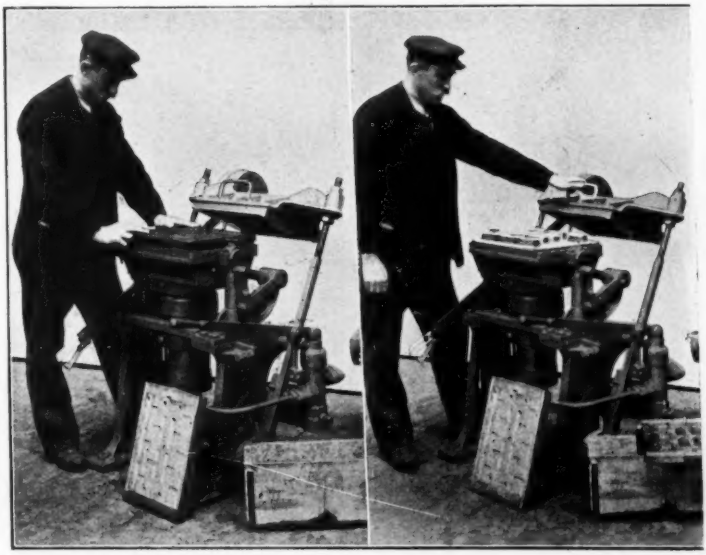

FIG. 1.—FILLING THE SAND IN THE INTERMEDIATE FRAME.

FIG. 2.—INTERMEDIATE FRAME REMOVED AND THE ROUGH CORES READY FOR PRESSING.

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A COMBINATION has been formed amongst the manufacturers of brass and iron hinges to put an end to the competition and low prices which have prevailed for some time past. A price-list has been drawn up, and heavy penalties are to be imposed for under-selling.

THE LONDON EMERY WORKS COMPANY'S CORE-MAKING MACHINES.

The London Emery Works Company, of Park, Tottenham, London, N., have numerous designs of core-making machines. The core-making machines in general use have been very successful in making parallel cores, in round, square, hexagonal, or other shapes, but it is not possible to make cores for cocks, for instance, on many machines. The core-making machine of the London Emery Works Company overcomes this difficulty, and is capable of making cores of almost any description, and in sizes from the very smallest up to about 6 ft. long, which is about the largest machine made at present, though there is no reason why larger machines should not be constructed.

The operation of the machine is as follows:—Plates are made giving the shape of the core, and, then, on this plate, an intermediate plate made of wood is placed. The sand is filled into the plate, which is then removed, leaving a rough form of the mould, and then it is pressed by hand or hydraulic power. During the pressing operation the surplus sand is pressed into the grooves round the core. This sand is blown away, a tray placed on the cores, the plate reversed, and the cores drawn out from underneath. These operations are shown very clearly in Figs. 1, 2, 3, and 4.

This machine is made in all suitable sizes, but the standard size for small cores is usually 16 in. by 12 in. Further, the machine is constructed for hand, hydraulic or pneumatic pressure, the hand machine being made in two sizes and the other machines according to requirements.

The machine is very quick in operation, and in many cases will turn out ten times as many cores as can be made by hand, whilst no skilled labour is required, and the cores are considerably better in appearance and stronger in use.

For pipe-making this machine is most useful for making tee, bend, and elbow cores, etc., and it has been proved that cores can be made in green sand for this large work very successfully.

Fig. 5 shows a core machine for core plates, 43 in. by 20 in., with hydraulic

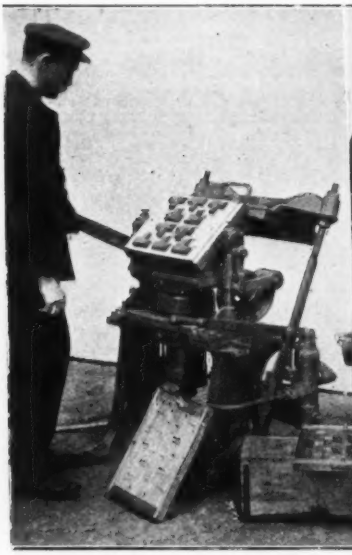

Fig. 3.—The Cores after Pressing.

Fig. 4.—Removing the Finished Cores.

power for pressing cores and also for extracting same, while Fig. 6 shows a pair of core plates for the above machine, 43 in. by 20 in. One man makes one core of this type in 5 minutes.

Fig. 7 shows the hand machine for use where founders have no hydraulic power available. With the exception of the pressure being applied by means of the lever the cores are made in exactly the same manner as with the power machine, viz., by putting the sand into the lower half of the core plate, on which the intermediate frame is then placed, filled, and removed. The extraction of the cores depends upon the shape, and is done in various ways, generally by turning the lower core plate over and drawing them down. Fig. 8 shows a pair of core plates, 16 in. by 12 in., for the hand machine. One lad makes two cores of this type in 9 minutes.

Fig. 9 shows a hand core machine for straight cores. It will be seen that this machine is completely enclosed, and has cast iron sides and top with a sheet extension to the table. The core bushes are made of gun-metal for the smaller sizes, and of cast iron for the larger. The machine is made in four sizes, producing straight cores of every description up to a length of 16 in. The machine is provided with a vertical gun-metal plunger, which can be adjusted by means of a hand wheel to the exact length of core required. The sand is rammed by hand, and by pulling the lever shown on the right, the core is pushed out. This lever works on a graduated quadrant.

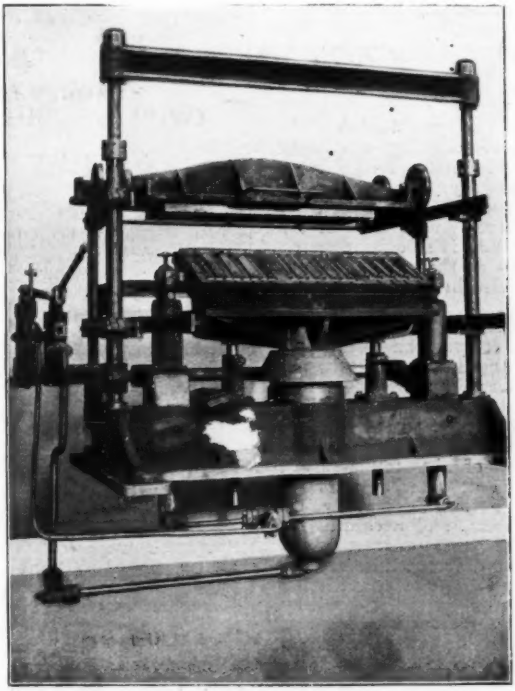

FIG. 5.—CORE MACHINE WITH HYDRAULIC POWER FOR PRESSING.

Figs. 10 and 11 show a core-making machine for making axle box cores. The machine shown is used for making the cores for the axle boxes on the Belgian State Railways. The cores turned out are perfect in every way, and no skilled labour whatever is required.

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Most foundries are using hand-made cores, but they compare unfavourably with the machine-made product. Practically all hand-made cores are rammed with some form of rod, which must of necessity result in very unequal hardness in different parts of the core, hence in unequal venting. Moreover, the core mixtures necessary for hand-ramming have to be worked wetter than those for the machine, taking longer time and considerably more fuel to bake.

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MODERN PIPE FOUNDING.*

By H. A. Croxton.

Pipe founding, as practised at the present time, while showing a decided improvement over methods pursued in the past, strange to say does not differ materially from the old-fashioned way of making pipe. There is no branch of the foundry business that is so dependent on tonnage for profits as the manufacture of cast-iron pipe. Within 10 years the required amount of tonnage which it is necessary to produce daily to enable the manufacturer to compete on a satisfactory basis has changed from 100 tons per day to 200 tons per day.

The subject of cast-iron pipe founding has received but meagre attention, and the principal reason for this is the fact that the majority of pipe founders are exceedingly careful as to what information they give out. This policy we believe to be narrow, and a careful investigation of the great progress which has resulted in the different lines of iron and steel manufacture, shows that the greatest results have been produced by those manufacturers who have been willing to exchange views with their competitors.

Probably the most important item to be considered in the cast-iron pipe business to-day is the general outline of the proposed plant. My remarks will be based on a pipe foundry with a daily capacity of 200 tons of finished product, or, more properly speaking, a yearly capacity of 60,000 tons. The plant should be located on not less than 40 acres of ground, with buildings centrally situated. The modern pipe foundry handles in and out of the plant 500 tons to 600 tons of material every day, and the handling of such a vast amount of material must be done at the least possible cost, and for that reason, starting with the pig-iron yard, which should be on a level with the cupola deck, the plant should be laid out on a 1 per cent. grade line down to the finished track which should be depressed. When you stop to consider that a modern pipe foundry produces and finishes complete a piece of pipe for every 40 seconds in the day, you will have a good idea of the nicety with which each department must do its work.

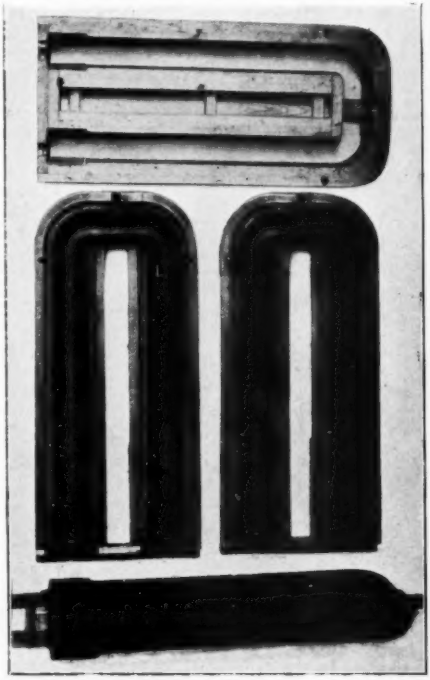

Fig. 6.—Pair of Core Plates, 43 in. by 20 in.

The pig-iron mixture required in making pipe is one that does not always receive the attention which it deserves. The writer was one of the first pipe-makers in the United States to establish a complete laboratory, and it has been our experience that iron mixed by a chemical analysis without paying any attention to fracture will produce better and surer results than any of the old-fashioned methods with which the writer

* Abstract of paper presented at the Cleveland (June, 1906) meeting of the American Foundrymen's Association.

is familiar. To obtain first-class results we aim to use not less than four different brands of iron in our mixtures, which nearly eliminates the evil effects which might arise from any one brand running irregular in its analysis. Each car of iron is analysed before using, and handled accordingly. The coke is also analysed, particular attention being paid to sulphur and ash.

The majority of pipe foundries in the United States start operations five o'clock in the morning, and in about an hour afterwards are ready to pour, which operation continues without interruption until about two o'clock in the afternoon. The flasks in which the pipes are cast are made of cast-iron, approximately 13 ft. long, with eyes in centre; these eyes are so placed that the flask is in good balance. After each pipe has been cast, by the use of an overhead travelling crane these flasks are taken out of the pit and opened up over a pair of skids, thus permitting the sand to drop into a shallow pit provided for this purpose while the pipes are rolled out of the main building. All the flasks are rammed up on the preceding day to casting; the moulds are dried over night, and should be dried thoroughly, as skin-dried moulds are very liable to cause trouble, especially after standing in the pit for several hours before being cast.

In our foundry we make three pieces, each of 3 in., 4 in., and 6 in. pipe in a flask; two pieces each of 8 in., 10 in., 12 in., and 14 in. pipe in one flask; 16 in. to 72 in. inclusive are cast singly. The cores are made in a "strike," and on sizes up to 12 in. the bar is made of wrought-iron pipe; on sizes above 12 in. the core bars are made of cast-iron. On sizes 3 in., 4 in., and 6 in. pipe loose hay is wound on the core bar until it is thoroughly covered, after which the first coat is put on, ranging about $\frac{3}{4}$ in. in thickness, this varying with the different sizes of pipe to be made. After the first coat is put on, the bars are loaded on a car with an electric travelling crane, and then dried in ovens conveniently arranged to receive the cars. About 11 o'clock in the morning the bars are taken out of the ovens and put in the finishing "strike," and the second coat is put on; before the bars are moved from the "strike" the cores are covered with blacking, and they are then replaced in the ovens to dry over-night. To ensure a perfect pipe it is necessary that the cores should be placed the following morning in exact central position in the moulds. To do this we use tapered socket on the chill plate, and the same taper is made on the core. At top of flask we use a slip socket core which drops into the tapered mould at top, and as it has a centrally located opening it ensures the top of core being held in exact central position.

After the pipes have been cast they are allowed to cool for about half an hour, after which they are taken out of the flasks and permitted to roll out of building to the cleansing department. About half of the material which is taken out of the pipe in the shape of burned core is taken back to the mud mills and ground over, the balance going to the dump. With proper care and skilled workmen, there is very little to do in the way of chipping. The gates must be knocked off, and any imperfections which

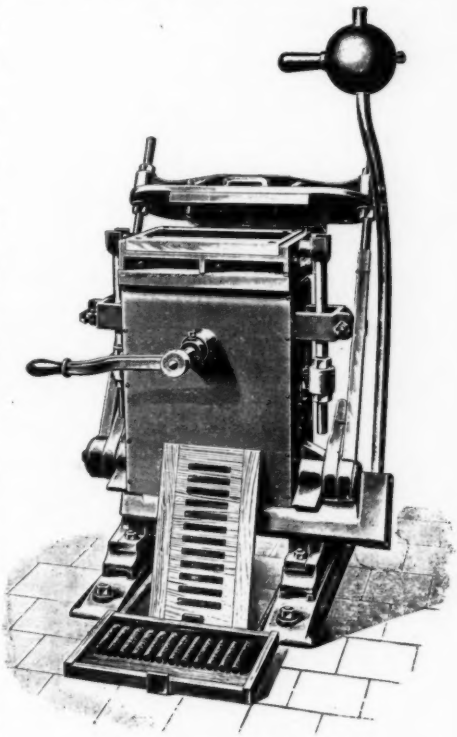

FIG 7.—HAND MACHINE.

show must be removed; for this purpose we have tried compressed air, but it has been our experience that a good chipper with chisel and hammer can clean more pipe than the most expert man with a pneumatic hammer. After the pipes are properly cleaned, they are run into an oven, which is built on the runway and operated with counter-balanced doors.

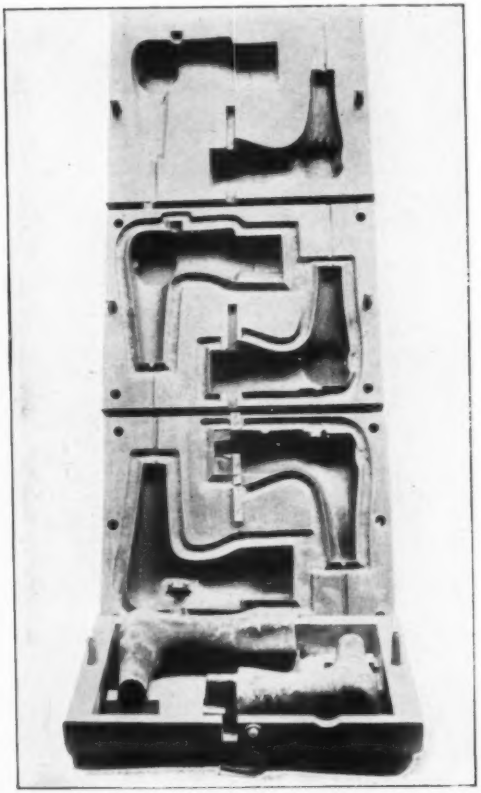

FIG. 8.—PAIR OF CORE PLATES, 16 IN. BY 12 IN.

This oven is long enough to permit a 72 in. pipe to make one complete revolution in going through same. In making this revolution the pipe has been heated sufficiently to permit of dipping it in tar, and after the dipping process, which is done by means of an electric elevator, the pipes are rolled out on skids. In about 10 minutes they are cooled sufficiently to make the tar set, giving it a coating which will preserve it after being laid underground. After the dipping or coating process, each individual pipe is weighed on a pair of scales built in the line of the runway, and each pipe is then tested hydrostatically to 350 lbs. per square inch.

The specifications and requirements of the largest users of cast-iron pipe have become so rigid during the past few years that, while they require a test of 300 lbs. per square inch, it has been our practice to test from 350 lbs. to 400 lbs. If the pipe breaks here at the mill, it is simply a matter of remelting the scrap, while if it breaks in the trench it causes all sorts of trouble and expense. There is a moral

FIG. 9.—MACHINE FOR STRAIGHT CORES.

obligation which makes it necessary for all pipe men to replace any defective material, and while in a great many cases the cause is one for which the pipe men should not be blamed, at the same time there is very little to do other than settle the contractors' bill for damages. After the testing of the pipes they are rolled into cars on the depressed track to receive them; if not, they are handled by

the locomotive crane and skidded on the yard for future orders.

Of the mechanical arrangements of a pipe shop, the three-motor travelling crane is the most important. The cranes which we are using are of our own design, and are built especially for pipe work. One crane is required to each pit where the square pit is used, and two cranes are required if the circular pit is used. The square pit has decided advantages over the circular pit, for the reason that a straight line is the shortest distance between two points. On the square pit the hook of the travelling crane can drop in approximately a straight line from any point to a desired point in the pit; with the jib crane this is impossible. The crane runners must be more skilled than in any other line of manufacture with which the writer is acquainted. We have tried crane runners who have come from the largest steel mills with the best of recommendations, and have found that they are unable to operate pipe-shop cranes satisfactorily.

Probably the most important feature in the operation of a cast-iron pipe foundry to-day is the pipe founder's ability to establish a first-class organisation, including all the skilled workmen required, and then he must be able to run his plant to its utmost capacity every working day in the year. The refuse from a cast-iron pipe foundry is also a matter that requires serious consideration. In our plant we have about 80 tons of refuse per day to take care of, and unless the shop is properly arranged and some provision made to dispose of this refuse, it means an additional item of expense. The wear and tear, or, more properly speaking, depreciation of a pipe foundry is extremely heavy, and I know of no line of business that more properly illustrates this than to compare it with a blast furnace.

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350-TON HORIZONTAL TESTING MACHINE AT LLOYD'S BUTE PROVING HOUSE.*

By J. Hartley Wicksteed.

There has been installed this year at Lloyd's Bute Proving House, Cardiff, a 350-ton horizontal machine of the author's design for the purpose of testing the largest anchors used in the British Navy, or the Mercantile Marine, with the statutory proof-load.

Fig. 2 shows a plan of the machine; Fig. 3 shows an elevation, partly in section, of the steelyard end of the machine; and a general view is shown in Fig. 1. It will take in anchors 17 ft. long in the stem, and 7 ft. 6 in. wide across the palms. It will impose the statutory breaking strain on stud links made of 4½ in. diameter iron, and in doing so has 40 tons of power to spare. This margin of power is, however, quite

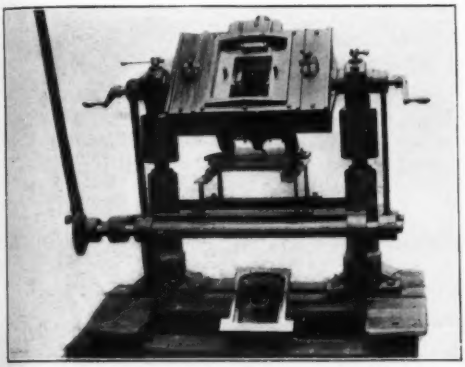

Fig. 10.—Core-Making Machine for Axle Boxes.

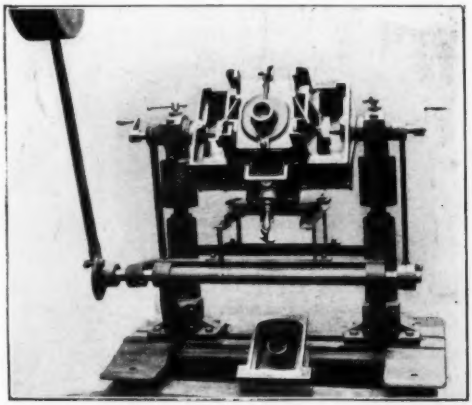

Fig. 11.—Core-Making Machine for Axle Boxes.

* Paper read before the Institution of Mechanical Engineers.

necessary to meet the excess of strength with which chain cables are now made beyond the statutory minimum. The scheme of the machine is set forth in Fig. 2, which shows a horizontal hydraulic cylinder in section with a ram having a 5-ft. stroke. This ram pushes out a sliding bed at the end of which a cast steel anvil is carried, against which the palms of the anchor bear. The stem of the anchor is shackled to the fork B, which is carried by a parallel frame supported on anti-friction rollers and made with a crosshead C at the back which delivers the pull on to the lever system.

In testing links the one link is attached to the fork A, the other end to the fork B, and as the hydraulic ram pushes out the sliding bed, it carries with one end of the link while the other is held from the fork B on the weigh-bridge, which delivers the pull as before on to the steelyard. The steelyard carries not only a travelling poise-weight but also a suspended rod, on the end of which standard weights can be dropped. By this means the scale unit is sufficiently large for testing ¼-in. diameter iron as accurately as large cables with 350 tons of load. But to make the same machine available for testing heavy and light loads with an equal percentage of accuracy, it is necessary, besides having a larger scale unit, to so construct the machine that the knife-edged fulcra may distribute the heavy load over such a length of bearing as to allow the fulcra to be brought to a keen edge to give sensibility for light work and still not to crush in doing heavy work.

Fig. 3 shows the main fulcrum, which is 6 ft. long, and it will be seen how rigidly both the knife-edge and the bearing plate are supported throughout their length, so that they cannot spring apart in the middle and thus bring more pressure on one portion of the bearing than another. The regulation of the Board of Trade, with which these fulcra comply, is that the pressure shall not exceed 5 tons per lineal inch of knife-edge. By using very hard steel it is found that the fulcra will stand endless repetitions of this pressure statically applied, but if they are allowed to chatter by the reactions of the machine when the rupture of the specimen occurs, they are liable to serious damage.

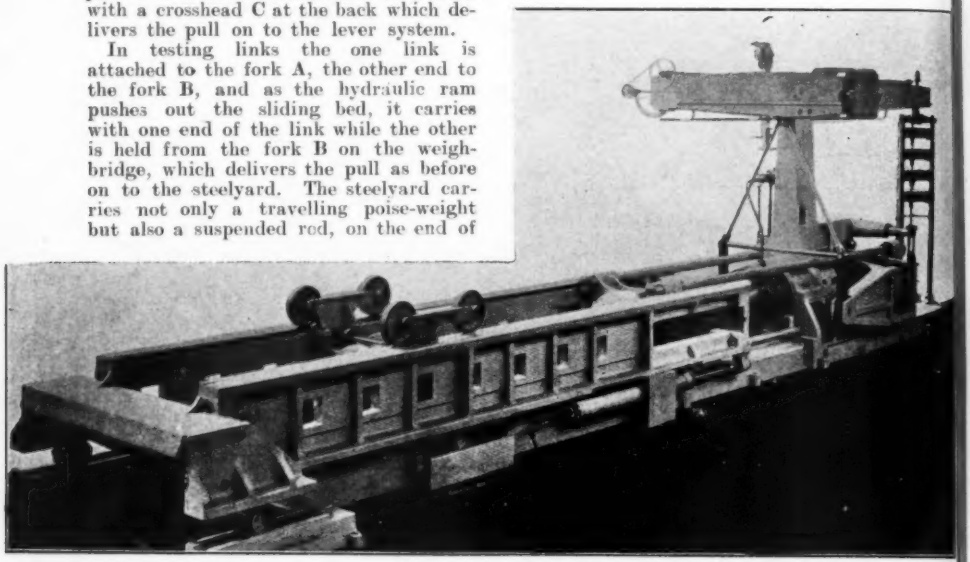

FIG. 1.—GENERAL VIEW OF 350-TON TESTING MACHINE.

The author gives an interesting description of the first testing machine ever constructed. It was started in 1829 from the design of Mr. William Williams. It is a curious coincidence that the machine of 1829 had the straining shackle free to rebound on the rupture of the specimen, while the lever system remained undisturbed owing to its being at the same end as the stationary part of the machine. Similarly, in the machine of 1906, the levers are mounted on the stationary part of the machine, and the straining crosshead is free to rebound without chattering the knife-

edges. Imagine the water in the cylinder compressed to 1 ton per inch, and a hard specimen fracturing suddenly, then the elastic compression of the water and the elastic recovery of the containing vessels tend to shoot the ram out of the cylinder. The design of the machine is such that all statical stresses are self-contained between the cylinder and the sliding bed, and are taken symmetrically along the centre of gravity of the sections. The bed-plate and foundations are inert and entirely unstrained, but when the piece breaks and the statical stresses are released the sliding-bed is free to shoot out and relieve the elastic pressures referred to, but the cylinder which carries the fulcrum plates is restrained from any perceptible recoil, first of all by its own mass, secondly because it is bolted to the bed-plate which underlies the whole length of the machine from end to end, as is clearly shown in the general view, and thirdly because this bed-plate is bolted and keyed to solid foundations. With this construction there is no sensible kick upon the knife-edged fulcra, and their accuracy is unaffected even by such violent reactions as take place on the sudden release of a 350-ton load.

The sliding bed in this form of construction enables a movable straining crosshead to be locked at any part of the bed, so that the straining head can be brought close up to the weighbridge to test as short a sample as a rivet, or rolled away to any suitable distance for holding longer specimens without the use of making up lengths.

The weight employed for measuring the load is divided between stationary weights at the long end of the steelyard and a rolling weight which by the introduction of a double-armed steelyard, originated by the author, counterbalances it by passing on to the negative end of the lever. Thus the rolling weight of half a ton on this machine is balancing another ½ ton concealed in the long end of the steelyard. As the poise-weight rolls, the concealed ½ ton is gradually released, so that the centre of gravity of the whole steelyard system travels at half the rate of the visible scale. The effect of this is that the scale-unit is double the size that it would be were a 1-ton poise acting on the long end of the lever only, and at the same time the required poise is only half the weight.

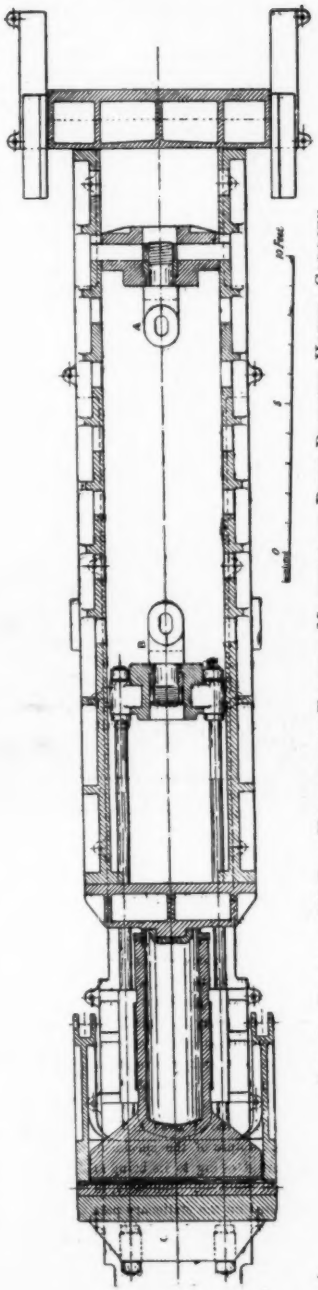

FIG. 2.—PLAN OF 350-TON HORIZONTAL TESTING MACHINE AT BUTE PROVING HOUSE, CARDIFF.

A further good effect of using a double-armed steelyard in connection with a rolling poise is that the unrecorded inertia resistances are only half what they would be if a single-armed steelyard were employed with a 1-ton weight with its zero on the axis of the steelyard; for in this case the positive arm of the steelyard would require to be balanced by a stationary counter-weight at the negative end, and the weight of the whole oscillating mass would be approximately double what it is when the poise itself counterweights the lever, by making its zero at the balancing point on the negative end of the steelyard. The double weight would arise as follows: Firstly, the concealed ½ ton of overweight at the long end would need to be balanced by an extra weight of equal amount at the negative end; secondly, the poise would double in weight; and thirdly, the whole lever would require to be made heavier to hold up at its long end a rolling poise of 1-ton weight with the same stiffness that it holds up the rolling poise of ½-ton weights.

The author comparing the Cyfarthfa machine of 1829 and the Cardiff machine of 1906, thinks that, considering the number of "sports" in the genus testing machine which have sprung up and died out or become obsolete during the intervening period, it is noteworthy to find that the Cardiff machine, for the installation of which Sir William Thomas Lewis is responsible, confirms the soundness of the main principles which were first brought into practice so long ago in the same county of Glamorgan.

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CLEANING CASTINGS WITH THE SANDBLAST.*

The operation of cleaning castings with the sandblast has been found so profitable and to improve the appearance to such an extent as to render the sandblast machine as indispensable as the moulding machine in modern foundries.

A number of special machines have been designed in Germany for this purpose, which may here be briefly reviewed.

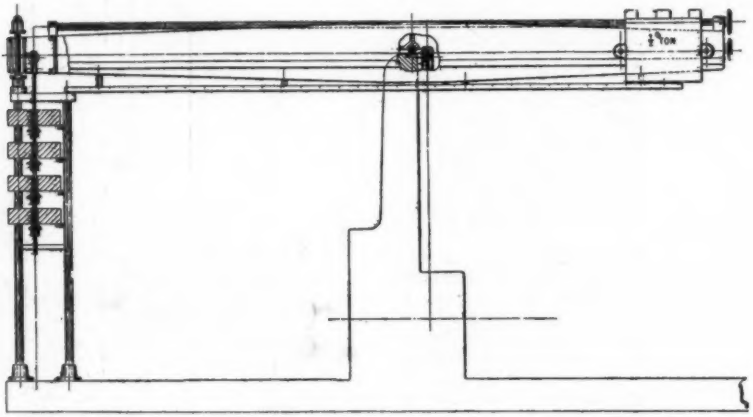

FIG. 3.—ELEVATION, PARTLY IN SECTION, OF THE STEELYARD END OF 350-TON TESTING MACHINE.

A typical example of the revolving table machine is that made by the Alfred Gutmann, A.G., and illustrated in Fig. 1. The standard pattern has a free working aperture of 14 in., but this can be increased to about twice that figure for special purposes. The only attention necessary is to charge the table, and then reverse the castings when one side has been exposed to the blast. The manner in which the table is covered has a great influence on the output of the machine, and it is desirable to pack small articles in between the larger castings in order to occupy the surface as completely as possible. One great advantage of the

* (Giesserei Zeitung)

sandblast is that it does not injure delicate outlines like the older cleaning processes; and another is that the treatment gives the pieces a uniform dull bluish grey colour, which makes them more saleable, especially in the case of ornamental castings.

Machine castings, too, treated in this way do not require any further working. Every engineer knows the strain placed on cutting tools, milling tools, reamers, turning and planing tools, in removing the outer skin on castings, which, however, can be done with comparative ease by the sandblast; and by prolonging the treatment, the effects of pickling are produced, the operation leaving the metal with a perfectly clean surface. To obtain the free jet desirable for treating castings that are too heavy or bulky to place on the table, the pipe from the blower can be disconnected and replaced by a flexible pipe and nozzle to be held in the hand; and as this pipe may be as much as 80 yards long, it is possible to use the jet for cleaning castings outside the building as well. The jet also forms an excellent means for blowing out large and complex cores, such as those of engine cylinders, the cylinders and pistons of rotary piston pumps and blowers, etc.

To secure uniform distribution of the blast over all parts of the castings on the table—this being essential for ensuring proper cleaning and preventing waste of time—the makers replaced the original reciprocating movement of the nozzles by a circular motion of varying velocity effected by the use of cam wheels.

The Gutmann machine, shown in Fig. 2, is suitable for cleaning long castings, such as pillars, waste pipes, radiators, and the like. The nozzles have a circular motion, and the pieces are carried on one or two endless chain bands, with bolted cast-iron traverses, arranged so that the blast does not touch the chains. The chains are carried on wheels running loosely on their axles, so that clattering and jamming are prevented. With the double carrier a saving of time and labour is effected, since instead of the half-finished pieces, having to be returned to the starting point, they are merely transferred to the second carrier and go back again through the machine. By introducing a change wheel, both carriers can be made to move in the same direction for cleaning pieces that are too large to be carried by one alone.

Certain classes of work require special machines, unless they are treated with the free jet, which is more cheaply and easily applied. This is particularly the case with articles of complicated form or unequal powers of resistance, the free jet then affording a means of giving the necessary differential treatment. The great difficulty hitherto in the way of the more extended application of the free jet, however, has been the high consumption of sand and the great inconvenience arising from the dust produced. These difficulties are removed by the Gutmann cleaning hut, Figs. 3 and 4, in which means are provided for drawing off the dust and

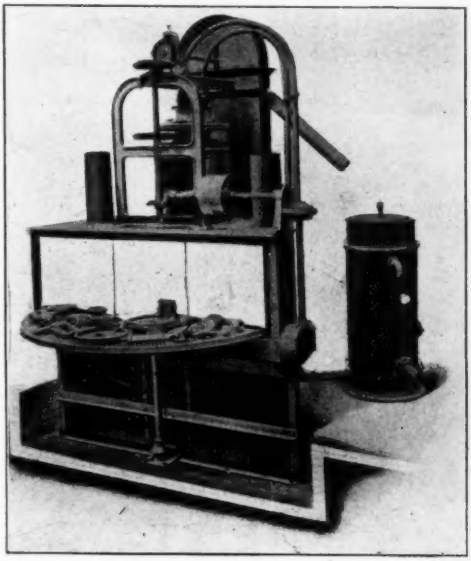

FIG. 1.—REVOLVING TABLE MACHINE.

saving the sand, which is returned automatically to the blower. The exhaust air current traverses that portion of the room in which the dust is generated, and removes the latter before it can reach the respiratory organs of the operator. On the other hand, the sand falling through the grid of the working table is returned to the vicinity of the blower by a worm conveyor underneath the floor, and is raised by an elevator to the blower, without having to be freed from dust. A transparent curtain in front of the operator protects his face from rebounding particles of sand. The hut has a wide door,

large windows, and a turntable large enough to take castings up to 5 tons, run in on a wheel track. Smaller articles can be placed on the turntable outside the hut, and the table is turned half way round. When the castings have been cleaned on the side next the operator, another half turn is given to the table, and the pieces can be reversed for finishing the other side. The table being on the floor level larger castings can be wheeled on to it and treated in the same way.

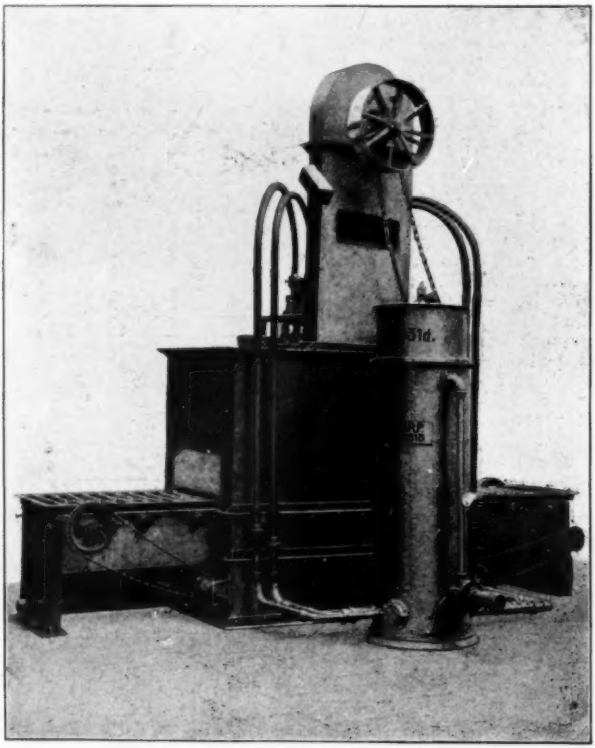

FIG. 2.—MACHINE FOR CLEANING COLUMNS, CAST PIPE, ETC,

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MESSRS. THOMAS SHANKS & COMPANY, Union Works, Johnstone, have placed contracts for an important addition to their well-known works. The new shop will measure about 360 ft. long, 72 ft. wide, and 50 ft. high.

A MOULDING PROCESS FOR CASTING CAR WHEELS.

THE PENNSYLVANIA MOULDING PROCESS COMPANY, Pittsburg, Pa., has been granted patents covering the United States and Canada for a new design of moulding machine for casting car wheels. One of these machines has been installed in the plant of the Pennsylvania Car Wheel Company, Allegheny, Pa., and is working very satisfactorily. It was designed by W. E. Connelly, general superintendent of the latter Company.

The machine occupies a space of about 50 ft. square in one end of the plant, the patterns used being all of cast iron, making them practically indestructible, thus doing away entirely with wooden patterns, pattern-makers, and pattern-

shop. The metal is tapped from the cupolas into large ladles holding about 7 tons each, and which serve as hot metal reservoirs, the operation of making the wheels being so fast that a constant supply of hot metal is imperative. From these large ladles the metal is poured into two smaller ladles, which are picked up by an electric hoist and taken to the moulding machine, two moulds being poured from each ladle.

The moulds, instead of being rammed by hand in the usual way, are pressed automatically by a presser with cylinders 24 in. in diameter and 10 in. long, the machine exerting a pressure of 95 lbs. per square inch. The moulds after being pressed by this machine are said to be absolutely perfect, and require no patching or slicking with moulder's tools, which is necessary by the old method of hand ramming. After leaving the hydraulic press the mould is finished by two men, who put on it a cast iron clamp, after which it is picked up by a Sprague electric hoist and placed on the pouring table, which will accommodate ten moulds at one time, this table revolving so that it comes under the ladle holding the metal ready to pour.

After being poured, the moulds are picked up by an electric hoist and taken to the annealing pits, of which there are 176, of uniform size, each pit accommodating about 20 wheels, where the mould is shaken out over gratings, the sand falling down through these gratings into a conveyor, which takes it back to the moulding machine, the hot wheels being lowered into these annealing pits, where they are allowed to remain about 144 hours, to allow thorough annealing.

The process is a continuous one, and the moulding machine at present is turning out about 300 wheels per day. Some improvements will shortly be made to it by which it is expected the machine will turn out at least 350 wheels per day. It is a remarkable fact that no moulders are employed about the machine, all work being done by ordinary labour.

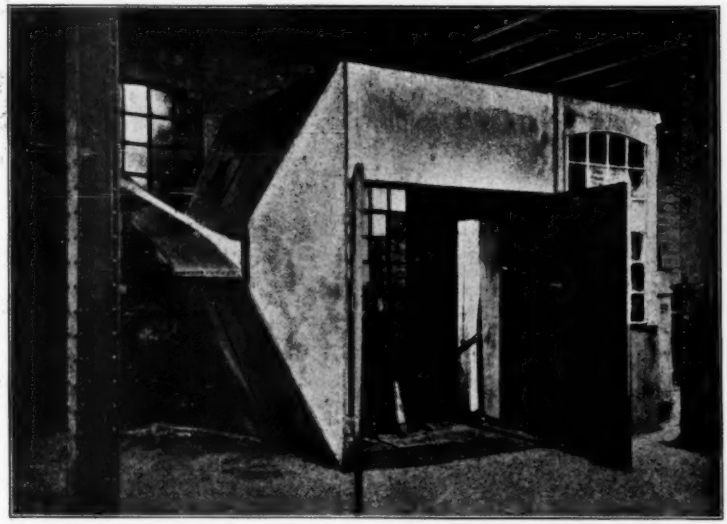

FIG. 3.—GUTMANN CLEANING CHAMBER.

The method of handling the sand for this moulding machine is unique, and permits a considerable saving in labour. The sand is conveyed from the shaking-out pit to an elevator, and is dropped automatically into a riddler. After being thoroughly riddled, it falls into another section of the sand conveyor, where it is tempered by water, and is then taken to the moulding machine by an overhead conveyor. Results have shown that water-

tempered sand is much better for use in car wheel moulds than when tempered by hand.

A valuable feature of this moulding machine is its simplicity of construction, it being adapted for installation in foundries having the usual equipment. The machine is capable of casting any size of wheels, from 12 in. up to 36 in. in diameter.—"Iron Age."

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MESSRS. HASLAM & SCHONTHIEL, of Cardiff, have been appointed agents, by the Adams Manufacturing Company, London, for the sale in the South Wales district of their "Igranic" motor and dynamo controlling apparatus.

A LARGE CRANE.

To assist in the erection of their works of large plant, Messrs. Markham & Company, Limited, of Chesterfield, recently put into operation an electrically-driven portable and turntable jib-crane of somewhat unusual dimensions.

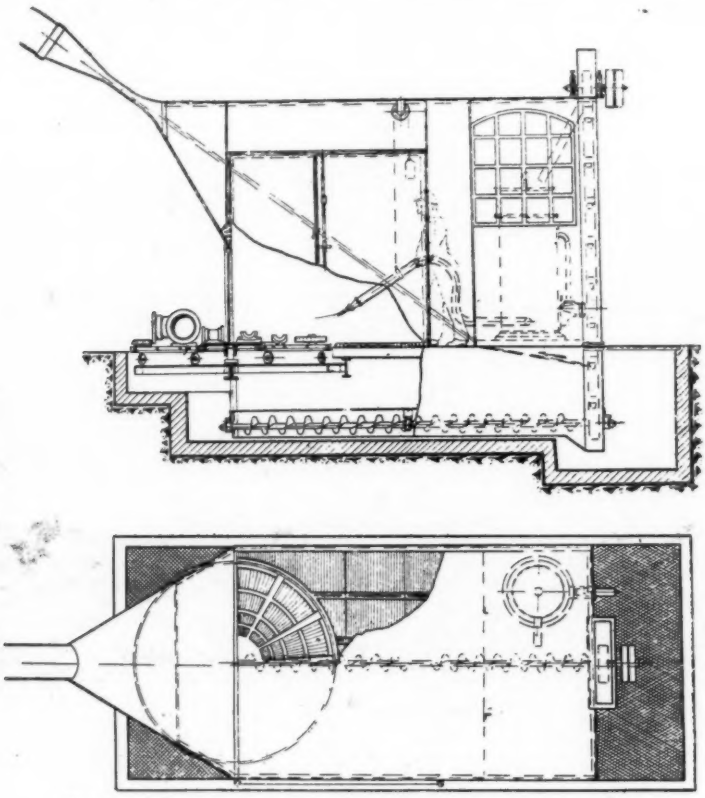
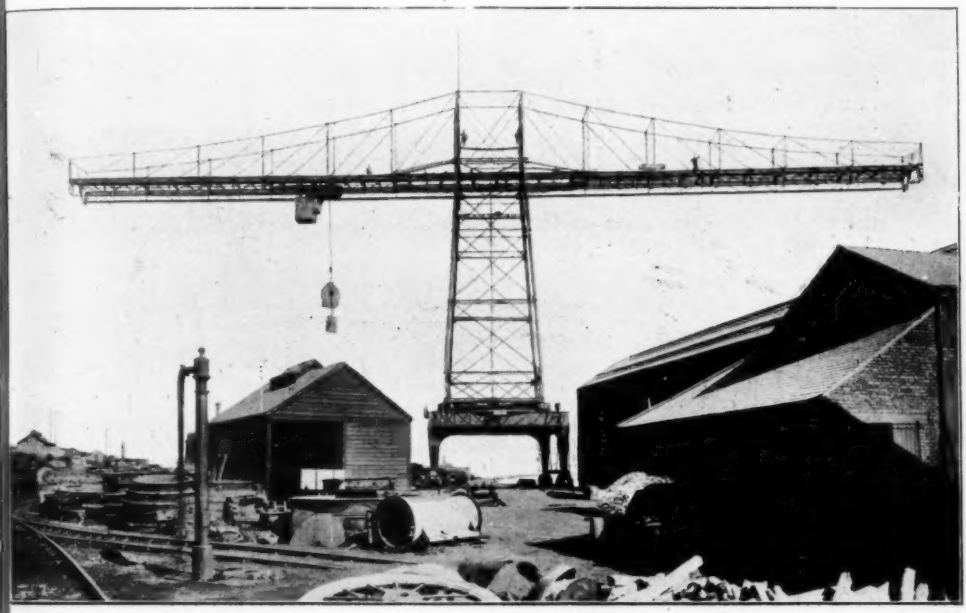


FIG. 4.—GUTMANN CLEANING CHAMBER: PLAN AND ELEVATION.

The crane, illustrated in the accompanying photograph, was supplied by the Duisburger Maschinenbau-A.G., of Duisburg, Germany. It consists of a portal, crossing two sets of railway of standard gauge, and a Goliath crane, with an arm stretching out at both sides. This crane is turntable on the portal around a pinion let into the middle. The track for the crab, being attached to the arm, runs from one end

of the latter to the other. It is only loads of unusually awkward dimensions which cannot be conveyed by the shortest way, between the supports, from one end to the other. In this case the revolving motion of the crane has to be requisitioned. The four corner-supports of the strong substructure of the portal rests on 16 wheels, which run on four rails. Every four of the running wheels are seated in one wrought iron bogie, connected with the leg of the portal by means of an equalising lever. By so doing, an assurance is given that the wheels are equally loaded.



NEW PORTABLE JIB-CRANE AT MESSRS. MARKHAM'S WORKS.

The lifting gear has been arranged for two different speeds, the lower one for loads from 5 to 15 tons, and the higher one for loads up to 5 tons.

The main dimensions of the crane and its working speeds are:—Lifting capacity: 15 tons at an outreach of 60 ft., 5 tons at the largest outreach of 120 ft.; highest position of the hook, 83 ft. 6 in.; height of the lower edge of the track of the crab above ground, 90 ft.; lifting speed, 30 ft. per minute for loads up to 5 tons, motor capacity, 16.5 h.p., and 10 ft. per minute for loads up to 15 tons; travelling speed of the crab, 65 ft. per minute, motor capacity, 8 h.p.; revolving speed, one turning in 5 minutes, motor capacity, 12.5 h.p.; travelling speed of the crane, 65 ft. per minute, motor capacity, 12.5 h.p. With the view to ascertaining the stability of the crane a load of 5 tons was carried to the largest outreach and then dropped, but in spite of the sudden unloading of the crane the latter proved perfectly stable. As will be gathered from our illustration, the crane is of an imposing appearance, and its outstretched arms can be seen for several miles around Chesterfield, a place which is world-famed by reason of the fact that George Stephenson lies buried immediately beneath the leaning steeple of the parish church.

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THE engineering works of Messrs. Howden & Sons, Wakefield, are to be closed.

SHRINKAGE.

By W. R.

The title of this subject covers one of the widest fields of mechanics, and nowhere does it work with more mischievous results than in the metals used in the art of founding.

Shrinkage is apparent in the vegetable world, brought about by atmospheric conditions and differences of temperature, but to ironfounders the shrinkage which takes place in the inorganic world is of the utmost importance. In dams, bridges, embankments, railways, and all other things moulded or cast, no matter whether they be of metal, or clay, etc., shrinkage is the most mischievous factor in all operations pertaining to those materials.

In metal work many articles which were formerly manufactured solid are now made hollow, thus increasing their strength, and with castings proportionating of thickness gives uniformity of shrinkage, uniformity of shrinkage creates elasticity, and elasticity gives strength and durability to resist impact, concussion, or undue strain of any kind.

The knowledge of the laws of expansion and contraction are, therefore, of great importance for work in the factory, forge, or foundry.

All metals cast in the form of machinery or otherwise shrink as they become solidified, and it is now our intention to consider shrinkage of metals in their primary condition and its effect in initial cooling, with special reference to heavy castings.

As nearly all metals shrink in proportion to their density, it follows that cast iron with its high percentage of carbon (at times reaching as high as 4 per cent.) shrinks less than other brands containing less carbon. Cast steel being a product of iron, but containing a comparatively small amount of carbon, shrinks much more than cast iron. Neither of these metals have any fixity of proportion in shrinkage, because of their variation in specific gravity. The more graphitic iron is, the softer it becomes, and, consequently, the lowest percentage of shrinkage belongs to the softest brands. These irons find a ready market for the pipe trade, agricultural rainwater, hollow work, and all light castings in a very general way. On the other hand, metals with a high percentage of shrinkage may, with judicious mixing, be confined to castings of an antifrictional quality, such as cylinders, slippers, slides, and bearings.

With most mechanics shrinkage appears in practice more as an external force, but with the founder its effects lie deeper, and may be regarded more as an integral force of shrinkage, known as "draw," "vacuum holes," "shrink holes," "segregation," and not infrequently by the misnomer "blowholes," which, perhaps, introduces the most debatable term of all. In this respect there appears to be some confusion in the terminology of metallurgy.

We are considering the heavy metal manufacture of castings, where textural construction is shown in its crudest and roughest form, and by so doing we arrive at the key to the question of internal shrinkage. Hence, with the softest or hardest of irons the gradation of reduced density, as thickness increases, becomes very apparent, for from 1 in. thick until we reach as high as 7 in. thick (which, by the way, was the metal of the old cast-iron Bramah press) we nearly, if not altogether, reach the disintegration stage. It has been observed, on breaking up these heavy metal castings, that the texture is so rough that by the aid of a pocket-knife applied to the shrivelled condition of the "break," small pieces of graphite, or, what is more technically termed graphitic eutectic (the graphite having separated itself from the iron), could be plucked out quite easily. This proves that with increased thicknesses, such as referred to, there must be a proportionate deterioration in the strength of metals so affected, clearly brought about by internal shrinkage. What applies to such heavy pieces as the Bramah press in a greater or less degree applies to all heavy castings. This, again, is more intensified at junctions or attachments, where internal shrinkage develops into integral disintegration; but, as a rule, those unsound junctions only reveal themselves while such castings are under the test of the hydraulic ram.

We now pass to the consideration of the shrinkage of metal, causing warping or twisting, due to unequal cooling. In this matter it is not so much a case of unequal distribution of metal as a question of conditions relative to the position of casting. Certain articles have a tendency to twist in cooling, but if turned upside down in casting the result would be quite different. For example, take for our pattern a casting of a V section and of equal metal. First,

cast with the bottom down; the bottom side of this casting will remain hot considerably longer than is possible with the sides, and, as a matter of fact, both ends would incline downwards, and thus concave the casting. Next, mould a second one from the same pattern, but with the bottom upwards, with the result that what was formerly the hottest part of the casting is now more exposed to the atmosphere, and, consequently, brings about a better uniformity of cooling, a result much to be desired, but at times a practical impossibility. There is no absolute rule of guidance in this branch of founding; everything cast has its own peculiarities in cooling, and nowhere do we find the trouble of warping more pronounced than by the shrinkage of light and hollow castings. Still, with such uncertainties, if we remember that heat in a general way draws towards its centre and the extremities of the same body will at the same time turn inwards, concaving of U section castings will inevitably follow when the face of same is cast downwards. Thus it is that camber in the bedding-down of sole plates and bearers of the U section and bedding in the position as mentioned above, requires to be deflected in the middle so as to bring those castings straight from the sand.

In this connection the responsibilities between foundry and pattern-shop is frequently disputed, and it lies with the founder to decide the question.

We next consider the intermediate or secondary stage of shrinkage, which is the plastic or viscous condition confined to internal shrinkage. It is obvious that castings of the hollow type, whose average thickness of metal may approximately be put at ¼ in. thick, do not lend themselves to the troubles of shrinkage attending the production of thicker metal castings. Because, if there be a plastic condition in light work, it must only be of momentary duration; consequently, no irregularities of shrinkage from integral "draw," as is common in heavy metal castings, can possibly take place. However, those engaged in hollow work may think they have plenty to contend with in warping—a trouble in shrinkage scarcely known to many heavy metal workers.

Thus far we have dealt with our subject in three divisions, namely, the philosophy of shrinkage from a moulder's point of view; secondly, shrinkage of heavy metal; and, thirdly, shrinkage of thin metal and its tendency to warp.

Nowadays, economy is practised in the machine-shops; what at one time consisted of so many separate parts of an engine or machine is now made in one casting, and very probably designed, in many cases, without regard to cracking, springing, or bursting itself in the process of "absolute shrinkage."

In connection with shrinkage in metal treatment, or, more correctly, the tempering of castings, there is abundance of material for a paper on "Cause and Effect of Shrinkage in Castings" which may have been too soon or too late lifted from the sand. With the former, by a premature exposure to the atmosphere, external shrinkage develops before internal shrinkage has properly begun, and is aggravated when valve seats and other internal adjuncts in effect consign a casting thus treated to a short life, if nothing worse happens, through such unguarded treatment.

Castings that are to be polished, but otherwise plain, even when cast with iron above the average density and price, if left too long in the sand brings on decarbonisation. Instead of getting a polished casting, with a bright lustre, we get a dirty, speckled-like article, an eyesore to the founder, and a short-lived article to the buyer, that is to say, if it belongs to the antifrictional grade of castings.

Thus, a poor and cheap brand may be improved, and a superior and costly one spoiled.

In designing castings, two things should be studied: the proportionating of metal for the better equalising of internal shrinkage, and the avoidance of objectional angles.

The interest involved in Keep's curves, which is another phase of this subject relative to the "three expansions," is worthy of all possible investigation, for truly there is much wonderful phenomena in the habits of metal, and the variation by the different methods of cooling is ample proof of this assertion.

The practical side of the question may be summed up thus:—Slackening internally and externally, wherever there be the least indication of anything such as brick, loam, hard, dry sand, core irons, or any other adjunct pertaining to a mould that is in any way likely to impede the progress of shrinkage.

Lastly, the multifarious phases of shrinkage and its treatment to avoid loss from springing, bursting, or warping, is at times somewhat difficult of explanation, for, whether it be camber, the ex-

posing of heavy parts, the application of cold water (such as in the cooling of bosses), the splitting of same in two or three places, or the running of metal in a gutter round the outside of a pulley or similar casting—all resolves on the one idea of uniformity of cooling.

If we could get this, together with no impediments in the process of shrinkage, neither warping, concaving, or convexing, breakage or burst of any kind would be possible, but just on account of those evils depicted here, which belong to external shrinkage, not to mention the all-important and vital question of internal shrinkage, proves this subject to be one of paramount importance to all users of metal, and more especially should it be to foundrymen.

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MOULDING MOTOR CAR ENGINE CYLINDERS.*

By L. N. Perrault.

The motor car has undoubtedly done more than anything else to develop the highest skill and accuracy in foundry practice. The Manufacturers' Foundry Company, of Waterbury, Conn., designed, built, and equipped a foundry especially for the manufacture of motor car castings. In this article it is aimed to give a detailed account of the method used in making one of the many types of cylinders produced in this foundry.

The drawings, as they leave the hands of the designer, are first carefully examined to eliminate any features which experience has shown are likely to cause weakness in the casting from sponginess, internal strains, cracks, etc., produced by unequal thickness in the walls of the casting and consequent contraction due to unequal cooling. The next point to be considered is the size and location of the core supports, which must be large enough to accurately locate and support the different cores in the mould, and to allow free and rapid escape of the gases and removal of wires and burnt sand from the cores. In placing these supports it is endeavoured to avoid uneven parting lines, which are so likely to make ugly seams on the casting, and add greatly to the time required to make the mould. These points having been investigated, the necessary additions to the drawing are made and it is sent to the pattern shop with all needed instructions relating to the materials to be used in constructing pattern and core boxes. If large quantities are required, these are made of well-seasoned mahogany, with all surfaces of core boxes, most exposed to wear, protected by brass binding and all pins and dowels made of brass, of ample size to insure perfect location and permanency. The pattern and core boxes being received from the shop are carefully checked before being put in the sand, care being taken to see that all loose pieces are so made and marked that they cannot be mislocated.

The pattern is next sent to the flask shop to have the flask fitted ready for the moulder. If a large number of castings are required, special iron flasks are made ready while the drawings are in the hands of the pattern-maker; otherwise neat wooden flasks are used. Meanwhile the coremaker has been given the core boxes and necessary instructions, and proceeds to bend wires to fit the various boxes. These wires are in bunches of 10 lbs. each, cut in yard lengths, and are kept on wall pegs in front of and within easy reach of each workman, who is supplied with cutters and pliers for handling the wire. In many cases the wires are made to assume very odd shapes as they follow the contour of the box, for by them every part of the core must be firmly supported so as to stand the pressure exerted by the molten iron. The removal of these wires plays an important part also in getting the core out of the casting, as the burnt sand becomes loosened and readily flows from the hole left by the wires.

Making the Cores.

In Fig. 1 are shown the core boxes and pattern, and in Fig. 2 the cores, lettered to correspond with the letters on the boxes in Fig. 1. Starting with the box A, Fig. 1, containing the top jacket core, which forms the water space on the head of the cylinder and is recessed to leave metal over the ports on the inside, a mixture of fine open grained bank sand and oil of a well tried formula is tucked into the box and so shaped as to fill one-half of the core space. Next the wires, previously formed, are carefully placed and securely tucked to avoid springing; then the vents are placed. These are formed by wax yarn made on the premises from a composition, the base of which is pure beeswax. This yarn is made in sizes varying from 1-16 to ¼ in. in diameter, and run into skeins about 100 ft. long. The vents are so laid as to form a network all through the core, their ends terminating in prints marked B and B on the pattern,

* From the "Iron Age."

these being the only support and vent outlets on this core. Looped wires or hangers are fixed at C and C, allowing the core to be firmly tied to the bottom jacket, part of the vent of which is carried through the top core into the prints at this point. The remainder of the core space is then firmly rammed, all loose parts of the box being held in position, the joints are struck off level, such loose parts as may be are removed and all soft spots are made right. Driers or forms are placed in position to support the hanging sand while it is green, and the core plate is rubbed to position. The whole is then turned over, the box lightly jarred with a rawhide mallet, all hooks, etc., loosened, the box withdrawn, and the core carefully examined for possible defects, such as exposed wire and vents, soft spots, etc. These having been dressed the core is removed to the oven. The finished core is shown at A in Fig. 2.

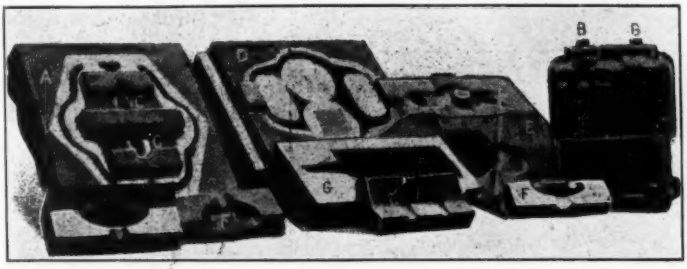

FIG. 1.—THE CORE BOXES AND THE PATTERN AT THE EXTREME RIGHT.

The coremaker proceeds with the box D, Fig. 1, containing the bottom jacket, which consists of the main box and loose pieces which form the outer wall of the cylinder barrel, the inlet and exhaust passages and the two core prints or supports. These being the only direct connected supports they must be strongly wired to stand the lifting pressure of the iron when the mould is cast. This core is made in substantially the same way as that for A, all wires being led so as to facilitate their removal as well as to strengthen the core. Vents are led to the prints and also to the thick part of the core, and holes $\frac{1}{4}$ in. in diameter are made at this point to connect with the hangers in core A, so that both cores can be tied together. The core having been rammed all loose pieces are drawn and supporting forms put in their place, the plate rubbed on, the whole rolled over, the box drawn, and the core dressed and carried to the oven. D in Fig. 2 shows this core completed.

Two port cores, E and E, are next made, being well wired, and all vents are led to prints which are also strongly wired, as they must support the weight of the barrel cores in the mould. The inlet and exhaust cores, F and F, come next, all wires and vents being led through prints which lock into the port cores at the vent passing down through the port prints. Lastly come the barrel cores, G and G. These, being much larger, are made of a more open sand of weaker mixture, with a strong rod and large free vent leading to the larger end.

All cores being put into the ovens are kept over night at what has proved to be the proper heat for cores of this class, the temperature being regulated with reference to a recording pyrometer. In the morning the cores are removed from the oven to the bench, and all forms are removed, the rough edges dressed, and a careful search made for any exposed vents, as at times the wax is displaced by the ramming and forced against the side of box. During the baking the wax is melted and absorbed by the sand, leaving a clear hole in its place. These vents, if displaced, are opened as far as they lie near the surface, and yarn of a smaller diameter is inserted, and the cut filled with new sand and dried, melting the wax and finally leaving a perfect vent hole. All cores are now given a coat of blacking by dipping them in a tub, the contents of which are constantly stirred to maintain the proper consistency. After a short period in the oven they are again taken to the bench, thoroughly dried, and are ready to be fitted and assembled. First,

both jackets, A and D, are put together and calipered to size (a variation of 1-16 of an inch in so thin a casting being prohibited); the jackets are now separated and the port cores E, fitted into the top jacket, the inlet and exhaust cores F are fitted into the ports and the bottom jacket is again put on to see that all parts line up and give the necessary thickness of metal. If correct, all parts are again separated and paste applied to the joints, wires inserted in hangers at C and C, all parts assembled and tightly pressed together, wires tied fastening the top and bottom jacket, all joints filled with slurry, and the finished core H, Fig. 2, placed in the oven to dry the paste. When dry it is removed to a storage rack until needed by the moulder. The barrels are then pasted after being calipered to size and dried, and are placed on the rack. This completes the coremaker's part of the making of the cylinder.

cores at the bottom. Prints G G support the bottom jacket and liberal provision is made for leading the core vents from each, as will be shown later.

As these cylinders are cast in green sand, the flasks, which are 18 in. by 24 in. inside, are of wood and strongly made. Fig. 4 shows these parts. They include two copes 6 in. deep, each having two bars conforming to the shape of the pattern to support the sand, and two cheeks of same depth with supporting strips around the bottom to keep the sand in while turning over and closing the flask, as the mould is rammed dome side up and reversed for coring and casting.

The mould board is laid on a level bed of sand, and the lower cheek placed on it. The corresponding part of the pattern is then properly located in the flask and facing sand, composed of one part of bolted sea coal to nine parts of fine new sand and three parts of heap sand, well mixed

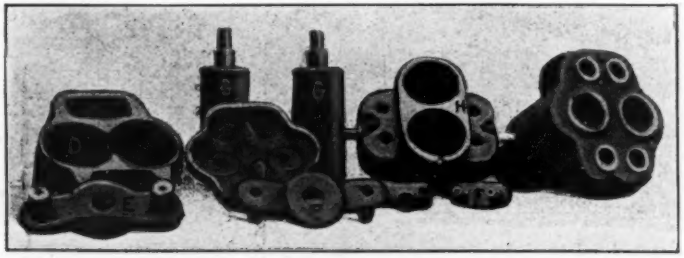

FIG. 2.—THE CORES AND THE FINISHED CASTING AT THE EXTREME RIGHT.

Making the Mould.

The twin cylinder when cast is 17 in. high and 12½ in. by 14 in. in greatest dimensions at the head or dome, ½ in. thick on the water jacket, and ⅜ in. thick on the barrels, and is shown in Fig. 3. The pattern is parted on the dome at the centre of the core prints, and also at the junction of the base and barrels, with loose bosses, four at D D and two at C C for inlet and exhaust pipes, to be drawn in after removing the main body of the pattern. These bosses are dovetailed into the pattern, doing away with the use of loose pins or dowels, which are likely to be lost and replaced by a nail or some other handy thing that might allow them to shift. Two core prints, E E, support the top jacket core. Four adjacent core prints support the two port cores, which in turn lock into and support the barrel and properly tempered, is then sifted on through a No. 8 sieve, and firmly tucked around the pattern. Two ¾ in. round iron rods are inserted through holes in the side of the flask and pushed through corresponding holes on the opposite side. These rods serve to support the sand under the dome when the mould is closed. The cheek is then filled with heap sand, carefully rammed, and the joint or parting made and parting sand put on. The second cheek, which has a row of spikes driven into the sides 1 in. from the bottom, is now put on top of the first, and a dry sand core having cast iron chills on the bottom edge is placed between the barrels, as this point is too delicate to be trusted to green sand. The chills are designed to quickly cool the iron, which at this point, the junction of the jacket and barrel, if left to cool in

the natural way is apt to be spongy and produce a defective spot in the bore that would render the casting useless, as the usual expansion of the cylinder while in use would allow the water to leak from the jacket into the bore.

Facing sand is again sifted over the pattern and firmly tucked up to the base of the chill core. Vent rods are then inserted through holes in the side of the lifting screw is then put in to raise the pattern when the cope is lifted off, the whole is filled with riddled heap sand, is rammed, struck off, the gate pins removed and thoroughly vented, the lifting screw secured by a bar and the cope lifted off, the screw removed and the hole left by it plugged with sand, the base pattern and gates withdrawn, the mould dressed, and the cope put back in place, the whole care-

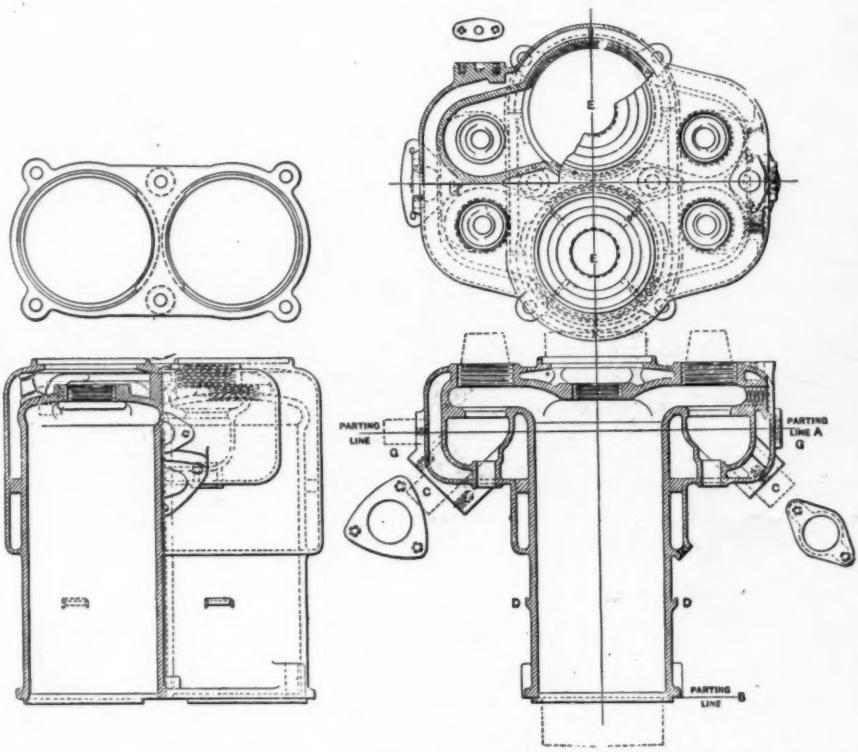

FIG. 3.—VARIOUS VIEWS OF THE CASTING WITH THE POSITIONS OF THE CORE PRINTS INDICATED.

flask into vent holes in the chill core, and heap sand is shovelled in and rammed to the top. Next the gate patterns, four in number, are bedded in and the joint made, the top of the dome pattern is put on, likewise the cope, the gate pins are set in place, the patterns covered with facing sand, and iron bearings, to support the core prints when rolled over, are put on each of the side core prints. A fully clamped and rolled over, the sand around pattern nailed, the joint made, and the top cope pattern and flask put on. Facing sand, as usual, is riddled on and tucked around the pattern, iron bearings are now placed on each of the side core prints to help support the jacket core, the lifting screw inserted, bars tucked, flask filled with riddled heap sand rammed up and struck off, a bed of soft sand is

spread over the top of the cope and the bottom board rubbed down to an even bearing, care being used, as there must be no hollows or soft spots which would allow the mould to strain. The board is now removed and the cope thoroughly vented with a $\frac{1}{4}$ in. vent wire, after which the cope is lifted off, turned over and laid on the bottom board, which has been laid on a level bed of sand. After slicking the joint the sand around the pattern is swabbed with a thin solution of molasses water, the pattern is lightly rapped and drawn from the sand, the swab is again lightly used on all projections and the edges of the core prints, and the mould joint of the cheek, the sand around the pattern swabbed and the pattern lightly rapped and drawn from the sand. The edges of the mould at the junction of the dome and barrels are secured with finishing nails, bosses C C, Fig. 3, are picked in and the corresponding cores are secured in place and the whole finished and blacked. This cheek is now lifted off and set aside, the four bosses D D in the second cheek are picked in and the mould finished and blacked, lifted off and set aside.

The loose sand is now cleaned out of the bottom cope, which, as already seen, was finished before rolling over. The moulder

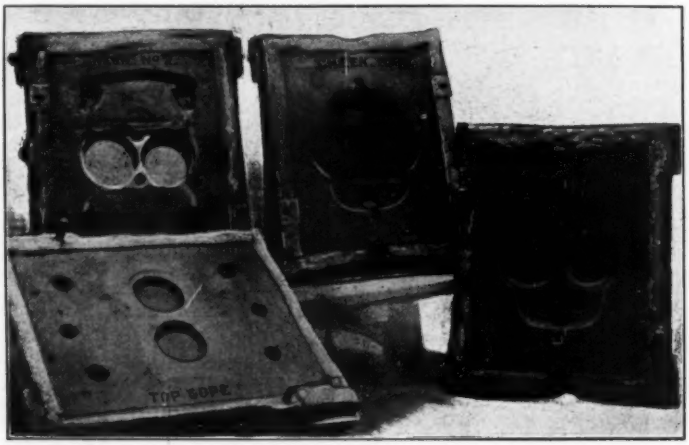

FIG. 4.—THE PARTS OF THE MOULD EXCLUSIVE OF CORES.

is dressed or finished with the necessary tools.

Provision is now made for allowing the gas to escape from the vents in the bottom of the jackets and port cores in this manner: Taking a hollow brass tube or sprue cutter, $\frac{3}{4}$ in. in diameter, the moulder forces it, in turn, through the sand at the centre of the bottom of each print down through holes bored in the bottom board for that purpose. The mould is carefully cleaned of all particles of loose sand by a bellows or cleaner and then given a coat of plumbago with a camel's hair brush. A dating stamp pressed into the sand leaves the date in relief on the casting, which can thus be readily identified at any time as belonging to that day's cast.

The parting sand is now brushed off the now takes a gasoline torch and dries the dome or water jacket part of the mould, which must be thoroughly dried, as the iron at this point is only $\frac{1}{8}$ in. thick.

This done, the mould is ready for the cores, which are now brought from the racks and laid on a board near the mould. The cores are carefully cleaned and examined by the moulder for any possible defects, and an iron gauge fitted over both barrel cores to make sure that they are of exact length, for any variation in these would seriously affect the compression of gas in the cylinder heads. A small noodle of flour and water is rolled and laid in the bottom of the jacket and port prints, encircling the vent holes, to prevent any iron getting into the vents whilst being cast. The jacket core, which, as before shown, also contains the inlet

and exhaust port cores, is now set in the mould, care being used to see that each part is properly aligned, as the variation of but a small fraction of an inch would shut off the metal and cause the loss of the casting. Straps are now inserted in the vent holes in the core at G G, and a channel cut in the sand leading to slots in the sides of the flask. The straps are laid in the channels and sand tucked over them and slicked down and flour paste put over the ends of the core prints. This method absolutely prevents the iron running over the cores and into the vents, which if not allowed a free quick exit would, in foundry parlance, cause "fireworks," and destroy the mould and cores. The lower cheek is now set in place on the bottom cope, and is in turn followed by the second cheek. The barrel cores, which lock into the port cores and are thereby accurately aligned, are next set in place, and a roll of noodle placed around the vent holes. A ¾-in. vent hole is punched through each core print in the cope over the barrel cores, the runners are made and the cope is put on and securely clamped. The vent straps are next drawn out from the flask and the mould is ready to be cast.

Casting.

Two ladles of hot iron are now brought up to the mould, carefully skimmed, and the mould poured while a boy with a hot skimmer lights the vents. When sufficiently cooled the runners are broken and removed, and the mould left to be shaken out and the casting removed to the cleaning room by the night force.

The next morning the cleaner removes all the core wires, using a hook, bar, and pincers for that purpose. The withdrawing of the wire loosens the burnt core sand, causing it to crumble, when it can be easily removed by lightly tapping the casting with a hammer and by a rolling motion which brings each core hole in turn to the bottom and allows the sand to escape. The casting is next sent to the emery wheel and the gates, etc., ground off; then to the pickle bench, where it is thoroughly drenched and allowed to remain all night. Next morning it is thoroughly washed with hot water, and after becoming dry goes to the testing bench, where it is subjected to a water pressure of 150 lbs. to the square inch and carefully examined for leaks, sweats, etc. This done, if perfect, it is marked and shipped.

ARMSTRONG MEMORIAL AT NEWCASTLE-ON-TYNE.

THE protographic view reproduced herewith depicts the statue to the first Lord Armstrong, which has been erected

THE ARMSTRONG MEMORIAL AT NEWCASTLE-ON-TYNE.

in Newcastle-on-Tyne. The monument has been executed in bronze by Mr. Hamo Thornycroft, and has been erected at a cost of £5,000. It represents the founder of the Elswick Works standing with uncovered head, and the inscription is simply, "Armstrong, 1810 to 1900." The ceremony of unveiling was undertaken recently by the Duke of Northumberland.

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A. HARPER & SONS, LIMITED, engineers, Dudley, have established a branch at City Buildings, 69, Corporation Street, Manchester.

CASTING ALUMINIUM.

In a brief article on this subject it is necessary to assume a general knowledge of brass-foundry practice on the part of the reader, in accordance with which aluminium castings are largely made. The purpose here will be to state those few distinguishing points wherein aluminium differs from brass casting.

Two characteristics of aluminium constitute what might be called the fundamental facts in the distinctions peculiar to aluminium foundry work. These are its lightness—it is one-third the weight of brass—and its high shrinkage, which is five thirty-seconds of an inch to the foot. Practically all modifications of usual foundry work are attributable to these two facts, and any steps, either traditional or independently devised, which cater to these peculiarities are so much in favour of successful aluminium casting.

The first point of distinction is in the construction of the mould. A snap or removable flask may be used for small castings and the completed mould placed on a flat board. This is possible because of the lightness of the metal. The next feature refers to the sand, which should be as dry as may be successfully worked. It is unnecessary to dry out the mould at all if sand with the proper degree of moisture is employed; in fact, torch drying is rather disadvantageous, since the slight overdrying of a corner or similar protrusion in the mould may cause it to wash. But the chief source of trouble, the stumbling-block for the great majority of moulders, is that of ramming the sand too hard. Have the mould as loosely packed as is compatible with safe handling and pouring. A close observance of this will probably obviate 75 per cent. of the difficulties experienced. The objection to the use of damp sand is the same as one of the reasons against hard ramming; if either or both occur, the metal seems to fail to lie close to the mould in spots, probably because the gases created by the over-damp sand cannot escape through the too tightly rammed mould. The great argument against hard ramming, however, lies in the high shrinkage of aluminium. The mould must be so made as to yield readily to this contraction, and to fail at this point will cause a loss of the casting by breaking. This tendency is augmented by the fact that at one point in the process of cooling aluminium is very "hot short" and will break readily.

Cores for aluminium castings should be as soft as will permit of safe manipulation. Green sand cores may be frequently used to advantage. There is little danger of their washing, they give smoother castings, and are more economical.

No set rules can be laid down for gating and risers, nor are these especially necessary. Their location and kind must depend upon the judgment of the moulder, such judgment being at all times amenable to the two characteristics earlier mentioned. One or two general suggestions, however, may be given. A liberal fillet should be employed where the gate connects with the casting, to avoid drawing just beneath this point. The use of risers is not so frequently necessary as the prevailing opinion indicates, but their judicious location is a safeguard against injurious shrinkage and they are absolutely necessary in some instances, such, for example, as a case where a chunky portion of the casting is separated from the main body by a small section. Chills may occasionally be used to advantage, though the cases requiring these are rare.

The next distinctions relate to melting the metal. Consideration of this part of the process involves a characteristic of aluminium which should almost take rank with the two fundamental peculiarities, lightness and high shrinkage, viz., the celerity with which it absorbs gases. Few metals are more active deoxidising agents than aluminium. The evidences of this, of painful interest to the foundryman, consist in pinholes. Every possible preventive should be adopted to overcome these, and mention of a few will be in order. Raise the metal as little as possible above the temperature at which it is to be poured, and do not allow it to soak on the fire after this point is attained, since overheating or continuous heating permits the absorption of gases and surely does not better the quality of the metal. A satisfactory method of cooling it down is to stir in new metal until the whole is of the desired temperature. Another precaution deserving emphasis refers to skimming. As stated, aluminium oxidises rapidly, and consequently has considerable dross on it. This should be very carefully skimmed, and in such a manner as to avoid immersing any of the dross in the body of the metal, since

this is liable to remain beneath the surface and pass into the casting. Skimming aluminium should be done with a degree of thoroughness even approaching waste, and to reclaim any metal which might thus be lost the skimmings may be remelted and the metal obtained run into an ingot for later use. It is of doubtful value to cover the surface of the metal with coke or charcoal dust, owing to the danger of its becoming disseminated through the metal.

The distinction probably most important next to that of light ramming relates to pouring the metal. Aluminium should be poured as cold as will give a thoroughly filled-out casting. To determine the proper temperature for pouring should be made a point of most careful observation, and it is one which varies, of course, with the shape of the pattern. In casting heavy pieces the crucible may he held near the cope and poured slowly, but in small or thin castings it is well to hold it as high as the metal will stream solidly—8 to 12 in.—and thus force the metal to remote parts of the mould.

After the sprue has set the casting is ready to remove from the sand. Trimming sprues may be accomplished in the ordinary manner or with a wood band saw having about four teeth to the inch, which is less liable to clog than the finer-toothed metal saws.

In an endeavour to emphasise a few points whose observance will facilitate successful casting this article may have so magnified them as to leave an impression that aluminium casting is attended with considerable difficulty. Such is not the case at all, and, in fact, the very opposite is true. When once these few peculiarities are mastered aluminium foundry work is very satisfactory, due partly to the ease of handling so light a metal and to its responsiveness to consistent manipulation. —"Manufacturers' Record."

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WILLANS & ROBINSON, LIMITED, have expended considerable sums upon patents, experiments, and developing work generally in connection with large gas engines. In view, however, of the successful development of the steam turbine business, the directors think it improbable that it will be worth while to make gas engine building a permanent part of the company's business.

NOTES ON MUMFORD MOULDING MACHINES.

BY A. A. SMITH.

THE writer has just returned from a trip to the United States, where he had the privilege of visiting many of the largest foundries engaged in turning out both jobbing and repetition castings.

The conditions in America are, of course, more favourable to the adoption of machinery, owing to the larger markets, as well as the practice of adhering to standard types and enabling the foundryman to spend more money on his patterns for machine moulding. In addition to this consideration, there is, of course, a keener search for speedier ways of getting out the work and more interest displayed by both superintendent and men in experimenting with new methods. The climate and general environments have a good deal to do with this activity, and it is interesting to note how that some nationalities, who, in this country will not develop sufficient energy for harder work than, say, grinding a barrel organ and vending ice cream, may be seen working like horses in the foundries over there. I remember in one shop noting 190 moulds laid down before four o'clock by a man and his little boy, who was as keen as the father in everything he did. The job was cast iron fittings made on a compressed air machine in a snap flask, and they had cores to set, in some cases eight cores in a box.

There are at present quite a number of power moulding machines on the market, but the most popular is the compressed air type, for the reason that compressed air is so convenient for other purposes, such as vibrating the pattern when drawing, cleaning off pattern, running sand sifter, and around large machines air hoists are in great requisition in the States.

Mr. E. H. Mumford, of Philadelphia, has embodied in his machine some improvements, and as my mission to the States was mainly concerned with the developments of machine moulding, I put myself in immediate communication with Mr. Mumford, who furnished me with introductions to the most up-to-date plants. One of the advantages of the Mumford machines is the absence of violent shock, In the Mumford machine the air is admitted slowly into the ramming cylinder, and a little dwell in the ramming has been found to be all that is necessary to

procure a harder pressure. The satisfactory results of this have been recently proved in the bottom ramming radiator machine, in which the head of sand necessary is provided for by having the pattern plate surface lower than the flask frame; the top, as well as the bottom, of flask is machined, and so positive is the ramming pressure that no surplus of sand remains to be struck off. On this machine which I witnessed making 5 in. radiator loops, two labourers made 148 boxes 10 in. by 40 in. in eight hours.

Another important point observed by Mr. Mumford in the construction of his machine, is the vibration of his pattern plate, so as to obviate the danger of mismatching. His vibrator acts vertically in the line of pattern draft, and a cross break of the sand where green cores are being dealt with, is prevented. The principle of drawing the flask pins simultaneously with the pattern.

There are naturally a good many other little improvements in the construction, such as the type of air valve used, the lubrication of the lifting cylinders, and the variation of speeds of lifting pistons.

The counter-balancing of the pressing head is procured by a strong spiral tension spring enwrapping the trunnion shaft, and in the multiple machine where the ramming head is a brass block carrying the half patterns, the presser head is operated with a simple power arrangement.

Jolt-ramming, for deep and complicated castings, is receiving the careful attention of American foundrymen at present. The failures which had hitherto attended this step have mainly been owing to the effort of moulding machine makers to combine the elements of drawing and ramming in one machine. Mr. Mumford has devoted himself to turning out a machine capable of completing the ramming operation in the most effective and economical manner, assuming that such a machine must be constructed to procure the following results:—

A dead drop: Centre of impact under centre of falling mass; impact always central.

The practice is to use this machine simply as a ramming table, on which may be placed either a stripping plate machine or a loose pattern on a follow board. In some shops in the States, a night gang shakes out, cuts over sand, and then with the assistance of travelling cranes, assembles the patterns and boxes laid out for the next day, rams up jobs, and at seven o'clock in the morning the moulders come in, draw the patterns and finish the moulds.

I visited one foundry who are installing jolt-ram machines for making tunnel plates, which weigh 19 cwts. apiece, and with eight labourers the output was figured at 63 moulds per day.

Mr. Mumford has also built a combination press and jolt-ram machine to deal with such jobs as have to be press-rammed in the top, but this does not in any way complicate the mechanism which in all moulding machines should be as simple as possible.

The question of multiple moulding, as perfected by Mr. J. A. Rathbone, of Detroit, has been fully explained by Mr. Mumford in his article published in this journal, and I need not go into this in detail. I visited one foundry in Providence, R.I., where they were making small cast iron fittings on Mr. Rathbone's process, and for such work this certainly is the speediest and most economical system I have ever seen in operation, either in Europe or America. One man lays down 60 moulds an hour, shovelling sand and closing, and I saw 206 moulds, which two men laid down in about 3½ hours, inclusive of setting cores, 6 in. to 8 in. in each mould. Mr. Rathbone had also installed several machines for the manufacture of small brass fittings. Multiple moulding is not, of course, entirely new, and in this country I have seen large boxes, *i.e.*, up to 3 ft. 9 in. by 20 in., cast seven tiers high, with rough work, but the class of casting dealt with by Mr. Rathbone was of entirely a different nature, and had not to be cored, but had to have a good skin.

With reference to match plate moulding, hitherto the palm has been held by the Falkirk "bairns," but I think we may expect to have shortly a few valuable pointers on that subject also from the other side.

The Rock-over machine stands in need of some improvements ere it can be reckoned as being of much help in our foundries, but once the draft arrangement is perfected we can look to this type to take care of a good deal of work which at present has to be done on the floor partly because of the pattern costs, and sometimes because the mould would not stand turning over after the pattern was drawn.

I think, however, that we may confidently look to overcoming the difficulties in getting a good draw on this type of machine.

CORRESPONDENCE.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Being a contributor to your journal, I write you to see if you can suggest any remedy to which I write you about. We are making, and have been for some time, casting 4½ h.p. water-cooled cylinders with which we are troubled after they are bored, and come to be tested to see if they are water-tight. When we come to put about 400 lbs. pressure on them at bottom of the cylinder, water seems to come in very small quantities, just a few drops, as if there might be a small hole about the size of a pin point. I should be glad if you could suggest any remedy for the above. I may say we dry the mould after we have tried the cores in, and cast them on their end.—Is it the cause of the jacket cores or is the metal too porous.

Yours, etc.,

B. M.

MOULDING AND CORE SANDS FOR PETROL ENGINES.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In reply to "J. J. H.," whose query appears in the September issue of the FOUNDRY TRADE JOURNAL, concerning suitable moulding and core sands for motor cylinders.

We have found, during many years' experience in this class of work, that there is a lot of unnecessary waste of time and labour trying to find suitable (fancy) mixtures.

Regarding facing sands for *small* motor cylinders, to be cast green, simply mix ordinary facing sand, as used for all light work; if possible, put it through the mill, as this helps to put a smoother face on the casting; plumbago the moulds and brush over with a dry camel hair brush.

In larger cylinders, say, from 5 in. bore upwards, we find it always best to use ordinary loam sand, blacked and dried in the usual manner. If at all possible, cast the cylinder crown downwards, as this gives the density of metal where most required.

For core sand, take equal parts of new and old sands, add a reasonable amount of horse manure, about the same mixture as good loam, mill it for a short time, not more than five minutes, and use in the usual way.

It is simply a necessity to use wax vents in this class of work, otherwise the work will never be so reliable, and never pay, for competition will not allow anyone to use the old-fashioned and out-of-date method of cutting vents.

All small jacket cores are best when blacked green, otherwise the wax will be found a source of trouble owing to it permeating the cores, and thus causing the blacking to run off.

Whenever we get a set of jacket cores we simply imagine the circular parts to be flat, then work on the same principle as though it were an ordinary large, flat core; this applies to the method of venting and bending irons.

Another point is to always keep a good outlet for the air to get away clear; do not make a good, clear vent, and then spoil it by filling it with ashes; always keep them open.

We think if these sands are used they will be found just as successful as all the (fancy) mixtures, which we do not hold with.

We think if these lines are followed there will be no more trouble with the castings.

Yours, etc.,

SAND.

MOULDING PROBLEMS.*

BY DAVID SPENCE, Franklin, Mass.

THERE is no industry that offers so wide a field for thought as the iron foundry. I started out as a foundry foreman when quite young, and one day the proprietor came along with a pulley pattern, 12 in. face, and 24 in. diameter. This he wanted used for a casting with a 16 in. face. After studying it over a while, I gave it to a careful moulder with the following instructions:—I had him put the pattern on six blocks, 2 in. high, and tuck the sand under the arms and hub. (It was a split pulley pattern.) Next he made his parting and placed the other half of the pattern on, ramming up the cope. After the cope was lifted off I had a wooden frame ready, this being the size of the flask. I had this screwed on the joint of the flask 2 in. deep, and again pulled up the other half of the pulley 2 in. and tucked under the arms and the hub, the same as in the drag. Great care was

* Paper read before the American Foundrymen's Association.

taken to nail the cope well, so that the 2 in. added would not drop off in closing the mould. I had good slides put on the flask, so that there would be a perfect joint, and the result was a good 16 in. face pulley casting.

While learning my trade, I saw a moulder making a pulley 8 in. in diameter, and 12 in. face. The pattern had a web instead of arms. I saw that he had a lot of trouble with it dropping. When he did get a good mould it would blow, and thus quite a number of castings were lost. I told the foreman that I thought I could overcome that difficulty, and had two pieces of pipe made by a tinsmith 6 in. in diameter and 10 in. long each, and also provided with a flange on one end. I had the tinsmith perforate these pipes on the side. I put the first half of the pattern down on the board and sieved a little sand on it. Then I placed my sheet iron pipe on the web and rammed it up carefully with a small wooden stick. After ramming it, I vented it well beside the iron pipe and then put on a good bottom board with a number of small holes in it to take off the gases. I then turned it over and put on the other half of the pattern, put on the cope, and rammed it up in the same manner, using great care in venting. When I drew out my pattern, finished the mould, and closed it up, I had no trouble from dropping, as the flange on the iron would not let it do so. I cast my pulley and had no trouble from blowing, using this method ever since, with good results.

I was starting up a new foundry in a small city where a great deal of saw-mill work was done. Before I had the core oven built and the crane in, a mill owner came with an order for a large pulley, 6-in. bore, and to be done at once. As I did not have a 6 in. core box made yet, and could not have dried the core if I had had it, I began thinking very quickly, and finally went again to a tin shop, got a pipe 6 in. in diameter and of proper length. I took this to the foundry and rammed it full of green sand and vented it properly, and next morning when the casting was turned out, it had a good smooth hole.

In one of the foundries I am running at present we have been doing a lot of mill work, and among this quite a quantity of large sprocket wheels with heavy rims and hubs. These would crack in the arms on account of the bad proportioning of metal in the design. To overcome this trouble I arranged to have the cope shaken out on the casting, and to bare the sand off the hub and the rim, leaving it on the arms. Then I had a ring made in the sand, and poured in melted iron. This held the heat in the arms as long as in the hub and rim.

——o——

PIPE FOUNDING.—III.

(*Continued from page* 408.)

By W. E. Cowens.

The patterns used for pit pipes are all of cast iron, and require to be carefully and accurately made. Fig. 17 shows the ramming pattern—it is of cast iron, about $\frac{7}{8}$ in. thick—it has a tapered

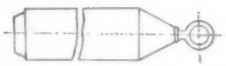

Fig. 17.

end at the base to fit into the socket pattern, and has a loose coned top for directing the sand into the mould. A wrought iron hanging bar passes through it, fixed by a nut and cross bar at the bottom, and provided with an eye at the top, for hanging from the lifting apparatus, required to lift it in and out of the mould.

The pattern is turned and polished on

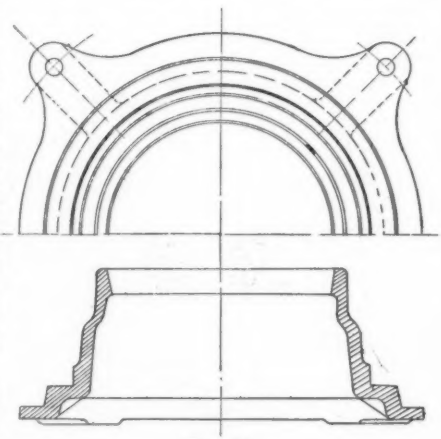

Fig. 18.

the outside to a diameter corresponding with the outside diameter of the pipe—measured with the contraction rule—the small taper at the base is turned con-

centric with the barrel to fit the top of the socket pattern. When completed ready for use the pattern should be

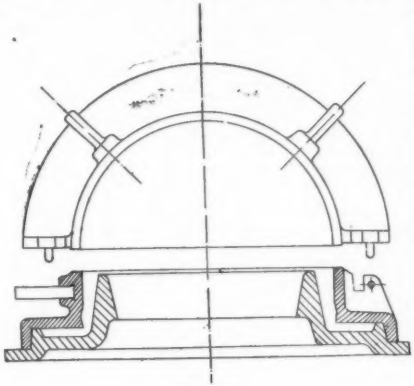

FIG. 19.

hung up and carefully balanced so as to hang absolutely plumb.

The barrel must be turned slightly taper to allow for drawing out of the mould after it has been rammed. It is desirable that the pattern should be the full length of the pipe, and on this length, if the bottom is made $\frac{1}{8}$ smaller than the top, it is sufficient. Fig. 18 shows the socket pattern in sectional elevation and half plan. The bottom flange is faced, and has a taper turned to fit the bogie, being cottered up by the four bolts shown in the plan. The outside of the socket is turned and polished,

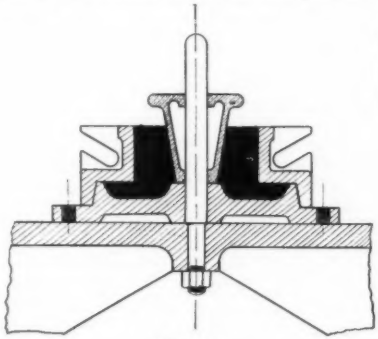

FIG. 20.

each of the surfaces having a little taper, so as to strip easily from the mould without bringing away the sand. The upper portion is bored out taper to suit the ramming pattern. It is necessary in putting the socket into position for ramming to see that the bottom face is close up to the face on the bogie—any tilting may cause a sided pipe. Some experience is necessary to define the amount of strip required, but it should be noted that a new pattern often gives trouble for a few days until it has got into working condition, and it is always desirable to work it for a time before altering the tapers to give more strip.

Fig. 19 shows the socket mould box in sectional elevation and half plan—for convenience the box is shown in position on the casting plate and kellet. The box is cast in halves, the joint being planed and fitted with steady pins; it is held together when ramming by two bolts, one on each side, and each half is provided with two handles for lifting. The inside is carefully bored out to correspond with the inside diameter of the socket. The taper at the bottom is turned to fit the

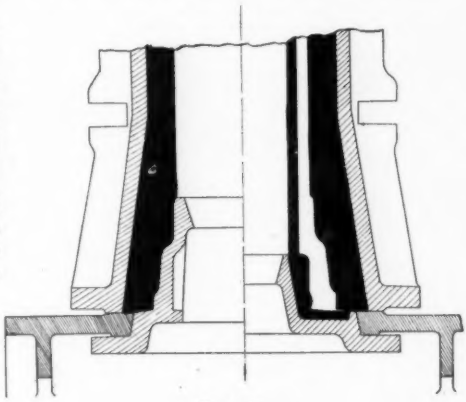

FIG. 21.

casting plate. The whole box is made as light as possible for convenience in handling.

Fig. 20 shows the socket mould box and casting plate used for the smaller sizes of pipes; it is made in halves bolted together precisely in the same manner as for the larger sizes, but the taper for the core bar is formed with a loose plug fitting on a central spindle. In this case a cast iron plate is kept on the core bench, and the casting plate has to be passed over the pin on this plate each time, to keep the plug concentric with the box. The

pin is turned and the plug bored out to fit it; the outside of the plug is turned to correspond with the taper on the end of the core bar. The box is bored out in the same manner as for the larger sizes.

Fig. 21 shows a sectional elevation of the whole of the parts put together. On the left the socket and ramming patterns are in position, and on the right the casting plate and kellet and spindle are in position ready for casting.

Fig. 22 shows a sectional elevation of the whole of the parts put together for the smaller diameter of pipes. On the left the socket and ramming pattern are in position; the upper portion shows the loose pin which slides over the ramming pattern to form the runner, and the spigot end of the pipe. On the right the casting plate and fluted core bar are shown in position. Two methods are used to steady and set the core bar. In the first method, as shown on the plan, a loam cake is made, having a central hole to fit the core, and the outside tapered to fit the mould. On the inside gates are rubbed out to form runners for the metal to pass into the mould. The difficulty with this method is to make the ring a good fit on the core without rubbing; when rubbing is resorted to, the ring may not be true with the mould, and the pipe in consequence be sided. The second method is to use cast iron wedges and a gauge stick for gauging the thickness to see it is set perfectly central in the mould. This method has also the advantage that the wedges leave holes in the head which can be used for lifting the pipe out of the mould. When the loam cake is used a chain has to be dropped through the pipe and a triangle hooked on to the end to catch the inside of the socket. Good pipes can be made by either method with careful workmen.

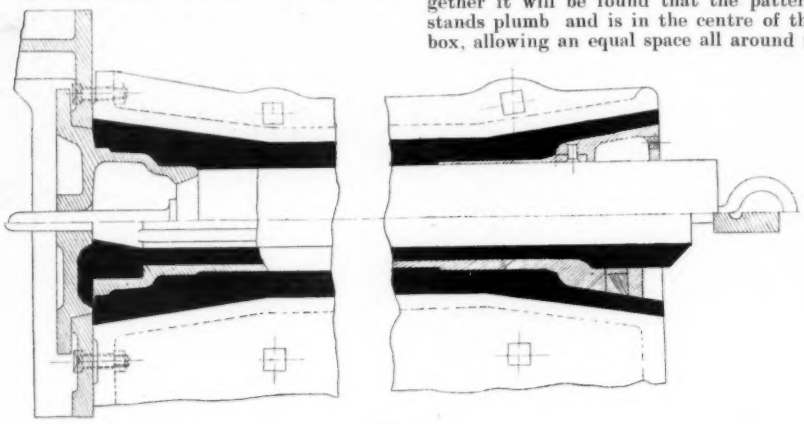

FIG. 22.

Having now described the patterns and moulds in use, it is necessary to describe the method of using them. The box, to commence with, is brought to the ramming platform, and the socket pattern is put up into position by a suitable winch. The ramming pattern is now dropped into the box and allowed to come to rest on the tapered portion of the socket pattern. If all the parts have come properly together it will be found that the pattern stands plumb and is in the centre of the box, allowing an equal space all around it for the sand. The sand is now thrown in, and ramming commences; with large size pipes three men are employed ramming, and the staging is so arranged that the men keep ramming and working round the pipe; a boy in the meantime feeding in the sand. As soon as they approach the top the loose head is dropped down over the pattern to form the runners and spigot end of the pipe. As soon as ramming is completed the loose head is pushed up and the pattern withdrawn. The socket is slacked off and taken down by the winch. The mould is now blacked off and the inside of the socket carefully examined and dressed if it requires it. It is now pushed into a stove or lifted over a gas jet and carefully dried.

The core has in the meantime been made by the coremaker, the spindle is first coated with a thin coat of loam and

dried, it is then brought out of the stove and the second and finishing coat is put on. This is then dried and the core is blacked off ready for the mould. The core may be either dried in rolling stoves or they may be on a bogie, and run into an ordinary stove; in either case the stoves are generally fired with producer gas. The kellet is generally made and dried in a separate stove. It is of strong loam to stand the face of the metal when pouring without breaking.

When ready for casting the box is placed on the casting way, and the kellet and core bar brought up to it and put into place. The loam cake or wedges are put into the head, and the core spindle secured and carefully set, when the mould is ready for casting.

After casting, and the metal has had time to set, the spindle is lifted out, and the casting plate knocked down. The pipe should now remain on the mould until it is sufficiently cool to be taken out without burning off the blacking. It is generally lifted on to the cleaning gantry, and until it is quite cool it should be occasionally rolled to prevent it settling down by its own weight and becoming oval. After cleaning the pipe is passed to the lathe, where the head is cut off. It is then blacked and tested, and is ready for delivery.

(*To be continued.*)

—o—

The Olympia Exhibition.

At the Olympia Exhibition at present being held in London, the Vincit Company, of 117B, Queen Victoria Street, E.C., are showing a grinding wheel composed of new abrasives having keen cutting properties and durability. It is said to be an absolutely safe wheel under normal conditions, and to ensure this claim each wheel is subjected to stringent tests before leaving the makers' works. The makers state that it has no hard or soft spots, remains quite cool under the heaviest work, and will not draw the temper of steel even when ground dry. The "Vincit" wheel works either wet or dry. The Company are running a wheel on their stand which will grind copper, brass, phosphor bronze, iron and steel without a particle of metal adhering to it. This entire absence of glazing will commend itself to users of grinding wheels, as apart from the trouble it causes in a large works, there is the expenditure in diamonds and time lost to be taken into consideration. The "Vincit" wheel is light in weight, and is free from odour when running.

Among the exhibitors are Messrs. Alldays & Onions, Selig Sonnenthal & Company,

and others, whose exhibits will form the subject of a subsequent article.

—o—

TRADE TALK.

Messrs. J. Bairstow and J. T. Smith, brass founders, etc., Bradford, have dissolved partnership.

Vickers, Sons & Maxim, Limited, are about to erect a new suite of offices at their Sheffield Works.

Messrs. Dobson & Barlow are removing their engineering works from Bolton to Ainsworth, near Radcliffe.

J. W. Jackman & Company, Limited, have removed their Manchester offices to 347, Chester Road, Cornbrook.

Messrs. Alan & John M'Culloch, engineers, have removed from 58, Renfield Street, to 140, West George Street, Glasgow.

Loudon Brothers, Limited, engineers, are at present carrying out considerable improvements at their works at Johnstone, N.B.

THE TREDEGAR IRON AND COAL COMPANY, LIMITED, are considering extensions to their works, and contemplate considerable expenditure in putting down new plant.

THE Abercarn Engineering Works and Foundry, which have been idle for some time, will be restarted at an early date, under the management of Mr. H. P. Bailey.

MESSRS. J. H. FOSTER, G. R. GREGORY, and R. GREGORY, engineers, etc., Brooksby Street, Islington, N., have dissolved partnership so far as regards Mr. J. H. Foster.

MR. S. H. BIDGOOD, 24 and 26, Wolborough Street, Newton Abbot, has been appointed sole agent in his district for Messrs. Bridgeman & Moore, ironfounders, of Compton.

VERY heavy damage was done at the Crescent Iron Works, Pendleton, Manchester, recently, by a fire which broke out in the timber and pattern sheds, which were totally destroyed.

THE improvements that are being carried out at the works of the Shelton Iron and Steel Company, Stoke-on-Trent, under the direction of Mr. W. H. Davies, engineer and general manager, are proceeding satisfactorily.

PALMER'S SHIPBUILDING AND IRON COMPANY, LIMITED, have associated themselves with a new shipbuilding enterprise at Genoa with a view to extending their operations in that direction, and of creating a market for some of their productions at Jarrow.

MESSRS. ANDREW BARCLAY, SONS & COMPANY, LIMITED, of the Caledonia Works, Kilmarnock, have arranged a scheme for the advancement of apprentices in their works. Awards will be made for evening class work, good timekeeping, conduct, and ability in daily work.

MESSRS. CAMMELL LAIRD & COMPANY have for some months been occupied with the extension of their works at Grimesthorpe. The company have put down an entirely new press shop, and new heavy machine shops are now almost completed. The company are also building an entirely new shell department, and an electric station is being constructed to provide power for the works.

THE Home Secretary has issued a notice stating that he has made an order extending to workshops in which the processes of file-cutting, making of iron and steel cables, chains, anchors, grapnels, etc., are carried on, the prohibition in the Factory and Workshop Act of the employment of young persons under the age of 16, and children without a certificate of fitness of the young person or child for employment.

MR. A. A. SMITH, of Glasgow, director of the firm of Messrs. J. W. Jackman & Company, Limited, of London, Manchester and Glasgow, has just returned from a trip to the United States, where he has been investigating the working of the Mumford moulding machines. Mr. Smith has brought back with him a great deal of information on the subject of these machines, which will no doubt be interesting to foundrymen who are contemplating installing moulding machines of the pneumatic type. Mr. Smith contributes an article on moulding machine practice, which appears in this issue.

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DEATHS.

MR. A. STEWART, engineer, Springhill, Muirkirk, N.B.

MR. E. GAMBLE, partner in the firm of Moss & Gamble Brothers.

MR. RONALD PHILIPSON, a director of the Consett Iron Company, Limited.

MR. R. HOWARD, who represented Hadfield's Steel Foundry, Limited, in South Africa.

MR. J. BLEZARD, head of Messrs. James Blezard & Son, of the Guy Foundry, Padiham.

MR. J. D. ELLIS, eldest son of the late Mr. Griffith Ellis, ironfounder, of Aberystwyth.

MR. J. HALL, secretary of the Sheepbridge Coal and Iron Company, at the age of 66 years.

MR. C. W. PHIPPS, manager of the extensive works of the British Thomson-Houston Company at Rugby, aged 47 years.

MR. H. SWINGLER, a member of the firm of Messrs. Eastwood, Swingler & Company, engineers, of Derby. He was a past-president of the Derby Society of Engineers.

MR. D. H. HAGGIE, of Sunderland, in his 57th year. The deceased gentleman many years ago took over the wire rope works of the late Mr. R. Hay, at Monkwearmouth, Sunderland, which he has carried on ever since.

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3155 Bridgeton, Glasgow.

PERSONAL.

The late Mr. J. W. Hedley, of Sunderland, ironfounder, left estate valued at £4,796.

The late Sir Bernard Samuelson, of Middlesbrough, left estate valued at £755,793.

Mr. Edward Nettlefold, of Guest, Keen & Nettlefolds, Limited, has been seriously ill.

The estate of the late Mr. T. Hardcastle, engineer, St. John's, Worcestershire, has been returned at £6,313.

Colonel J. S. Ruston, chairman of Ruston, Proctor & Company, Limited, Lincoln, has consented to be nominated for the Mayoralty for next year.

Colonel C. J. Stoddart, chairman of the Parkgate Iron and Steel Company, Limited, has been asked to accept the office of Mayor of Rotherham for the coming year.

THE "LEEDS"

COMBINATION MOULDING MACHINE.

This Machine is now ready for the Market, and the first Machine has been sold and delivered.

It consists of a Hand Press Machine capable of taking boxes up to 26 in. by 15 in., provided with a turn-over pattern plate; also Rapping Device, etc.

Full particulars on application.

We also supply Cupolas, Ladles, Mixers, Core Machines (2 types, several sizes), Bar Testing Machines, Pneumatic Chippers, Pneumatic Rammers, Pneumatic Riddles (3 types), Moulding Machines (4 types), Foundry Sundries.

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Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

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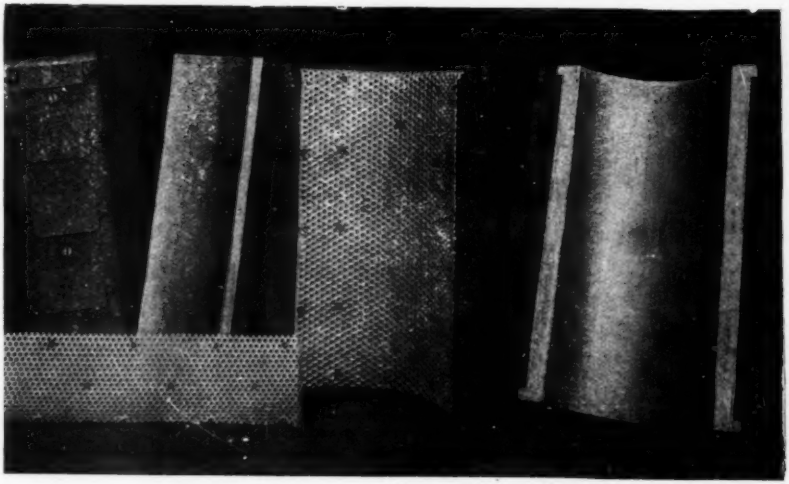
The Illustration shows a Crank-Shaft Bearing, consisting of Steel Shell with Bronze or Steel Skeleton embedded in "Glyco."



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LIBERAL TERMS TO THE TRADE.

NEW COMPANIES.

BRADFORD STREET (BIRMINGHAM) ENGINEERING COMPANY, LIMITED.—Capital, £2,000, in £1 shares.

PILKINGTON & GIBBS, LIMITED.—Capital, £5,000, to carry on the business of engineers, etc. Registered offices: 7, Lime Street, Preston.

DARTFORD RAILWAY WAGON AND ENGINEERING COMPANY, LIMITED.—Capital, £5,000. Registered office: Dock House, Billiter Avenue, E.C.

CHRISTY BROTHERS & COMPANY, LIMITED.—Capital, £12,000, to acquire the engineering business carried on at Chelmsford by Christy Brothers & Middleton.

BRIDGETON FOUNDRY COMPANY, LIMITED.—Capital, £4,000, to acquire the Barrowfield Foundry, Bridgeton, Glasgow. Registered offices: Colvend Street, Bridgeton, Glasgow.

C. COOPER & SONS, LIMITED.—Capital, £1,600, to acquire the engineering business carried on as C. Cooper & Sons, at Radcliffe. Registered office: Seed Street, Radcliffe, Lancashire.

HYDES & WIGFUL, LIMITED.—Capital, £10,000, to acquire the business of engineers, etc., carried on at Sheffield by Hydes & Wigful. Registered offices: Stanley Street, Sheffield.

EREBUS MANUFACTURING COMPANY, LIMITED.—Capital, £10,000, to acquire the business of engineers, ironfounders, etc., carried on at Willenhall, Staffordshire, as E. Raybone & Sons.

RILEY'S FOUNDRY COMPANY, LIMITED.—Capital, £2,000, to acquire the business of moulders and ironfounders carried on at Bury as Perryman & Worth. Registered office: Brook Street, Bury.

DORMAN, LONG & COMPANY, LIMITED (South Africa).—Capital, £10,000, to acquire the business carried on by Dorman, Long & Company, Limited, in South Africa. Registered offices: Zetland Road, Middlesbrough.

CLYDEBANK ENGINEERING AND SHIPBUILDING COMPANY, LIMITED.—Capital, £70, in £10 shares, to carry on the business of agents in London for John Brown & Company. Registered office: 8, The Sanctuary, Westminster, S.W.

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The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

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Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

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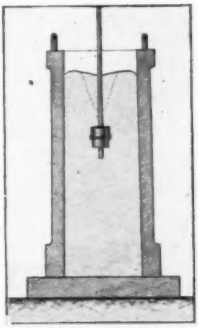
Reducing Piping in Steel Ingots.

STEEL BLOCK SHOWING PIPING.



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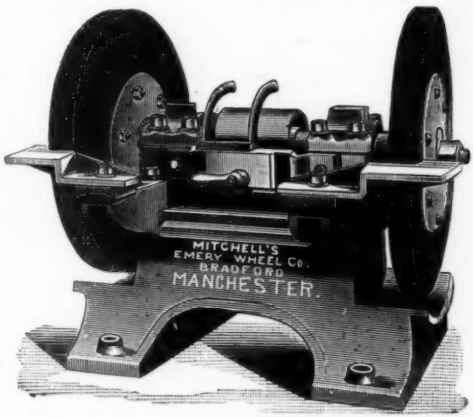

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PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1905-6.	1904-5.
Iron—Scotch pig warrants ... ton	59 9	—
—Middlesbro' warrants ... ton	54 9½	49 11½
—W.C. M/nos Bessemer ... ... ton	68 6	62 6
—Stock, Scotch, Oct. 1 ...tons	11,064	16,700
Copper—Chili bars, GMB ... ... ton	£93 2 6	£71 2 6
—Stock, Europe & afloat... ... tons	12,483	16,304
Tin—English ingots ton	£195 10 0	£148 5 0
—Straits ... ton	£195 0 0	£147 5 0
—Stock, Ldn. Hlnd and afft ... tons	13,235	14,237
Lead—English pig ton	£19 0 0	£14 7 6
Spelter—Ord. Silesian ... ... ton	£27 12 6	£27 0 0
Quicksilver-(75lb.) bottle	£7 0 0	£7 5 0
Antimony—Regulus ... ... ton	£106 10 0	£62 10 0

*Settlement price.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 15 0	to	7 5 0
Pipes, 1½ to 2½ in.	5 2 6	to	5 7 6
„ 3 to 4 in.	4 15 0	to	4 17 6
„ 5 to 8 in.	4 12 6	to	4 15 0
„ 10 to 16 in....	4 12 6	to	4 15 0
„ 18 to 24 in....	4 12 6	to	4 15 0
Chairs	3 15 0	to	3 17 6
Floor plates (open sand)	3 5 0	to	3 7 6

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: —Heavy wrought (mixed), £2 13s. 6d.; light wrought, £1 6s.; heavy cast, £2 6s.; all per ton f.o.b., London. Copper (clean), £82; brass (clean), £55 10s; lead (usual draft), £17; tea lead, £15 5s.; zinc, £22 15s.; all per ton delivered merchant's yard.

SILICA FIRE BRICK Co.,

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GROUND GANISTER,

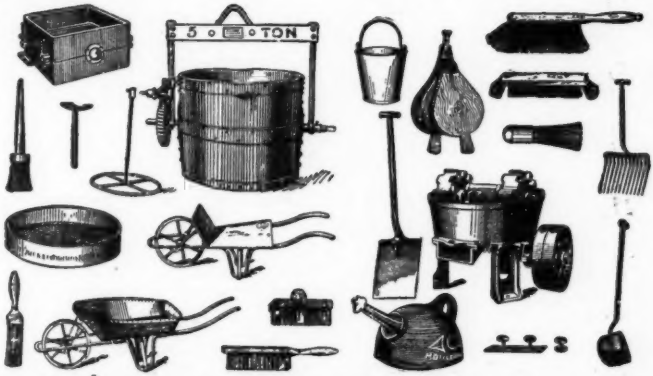
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

FOUNDRY EQUIPMENTS,

Composition Black Lead,

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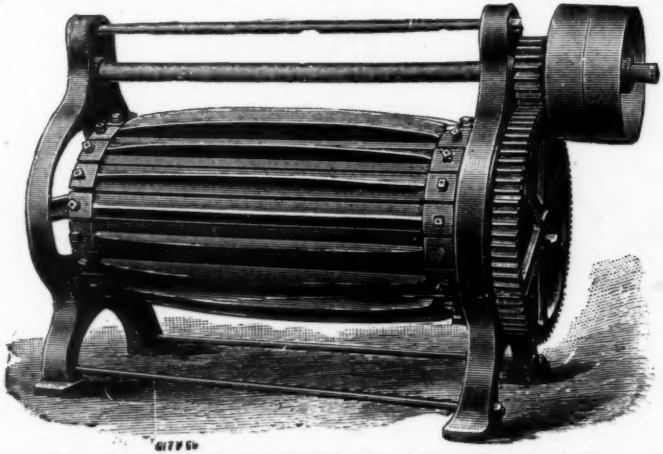
Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



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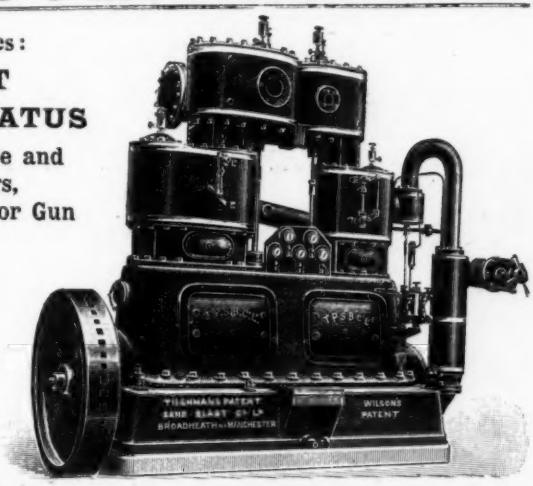

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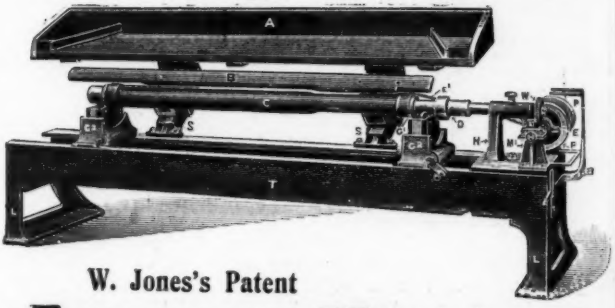

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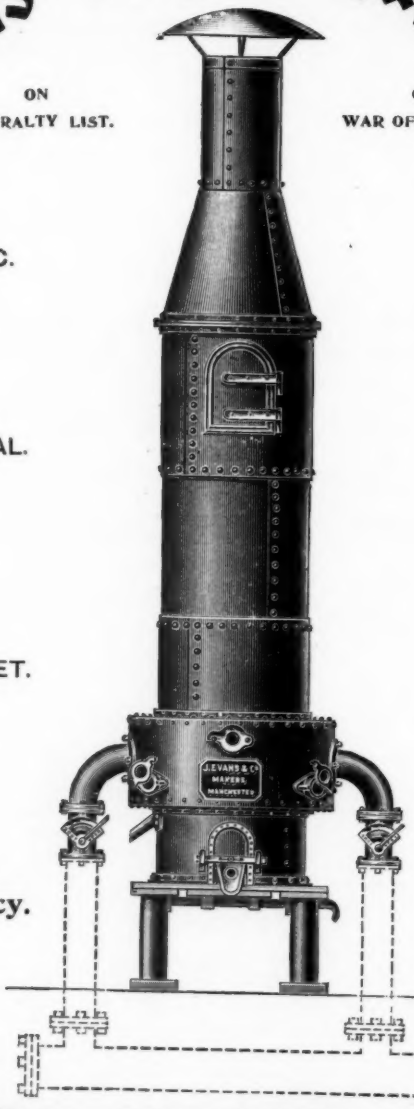

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